REPORT ON THE EXPLORATION
OF THE
SCRAFFORD ANTIMONY PROPERTY
Eagle Creek Area,
Fairbanks District, Alaska,

By

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December 15, 1973.

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S U M M A R Y

Exploration and development to date has exposed and indicated a "proven tonnage per vertical foot of 297 tons, at the surface, grading 11.3%Sb across an average true width of 8 feet" in two veins combined. The No.1 Vein averaged 13.5%Sb over 9.3 feet and the No.2 Vein 5.5% Sb across 4.7 feet. Both veins are open in strike and depth extensions. Four other veins, containing economic values across mining widths, await more thorough evaluations. The geochemical survey results revealed several other potential mineralized zones. Base on the foregoing infomation it is apparent that an excellent situation exist in proving up ample ore reserves to sustain a future mining operation

Results to date indicate the property contains a surface exposure of 953 probable tons per vertical foot. If this is considered at half square it calculates to 540,000 tons of "possible" ore inferred by surface work completed to date. Should this ore be identical to that previuosly developed (i.e. 11.3%Sb over 8 feet of true width), then every justification exists for a 500 t.p.d. milling and mining operation.

The ores and concentrates from this property are of premium quality because of the absence of deleterious smelter impurities and the carriage of appreciable amounts of by-product gold and silver. Preliminary metallurgical tests achieved better than 90% recovery, by flotation, on the stibnite but poor recovery on the antimony oxides. Test result concentrates from a 9.54%Sb feed of the No.1 Vein averaged:- 63.89%Sb, 0.21%As, tr. Pb, 0.45 oz/ton Ag and 0.09 oz/ton Au. The No.2 Vein concentrate, from a 8.74%Sb feed assayed:- 52.16%Sb, 0.57%As, tr. Pb, 0.60 oz/ton Ag and 0.64 oz/ton Au. The No.1 Vein feed consists of stibnite ore, whereas the No.2 Vein feed contains a high proportion of antimony oxide ore.

The Scrafford antimony property is 11 miles north of Fairbanks, Alaska. It is underlain by Precambrian Birch Creek schist and intruded by Mesozoic granitic stocks and dykes. The veins are composed of stibnite and some antimony oxides with by-product gold and silver in a clay gouge and quartz gangue. They are localized along segments of strong shear zones. The deposits are mesothermal and are genetically and spatially related to the Mesozoic intrusives. They are remarkably similar in geologic settings to the Hsikwanshan antimony mines, which at one time were the largest antimony producers in China and the world.

An unprecedented demand for antimony usage in flame retardants could result from the passing of U.S. government legislations, this year, requiring the flame proofing of children's night wear and the interiors of automobiles and other passenger carriers. Recent utilization of high purity antimony in the manufacture of semi-conductors and thermo-electric devices augments new consumption patterns. These new demands are certain to raise and stabilize the future antimony price and prevent its historically wide price fluctuations.

A follow-up evaluation program estimated to cost $128,000 is recommended.

Siak S. Tan

Siak S. Tan, B.Sc.,P. Eng.

INTRODUCTION:

The following report is based on results of an exploration programme conducted on the Scrafford Antimony property between March and September, 1970. The writer acted as a resident geologist on the property during the period May 7-August 15, 1970. Periodic supervisory visits were made by Mr. L. J. Manning, P.Eng., of L. J. Manning & Associates Ltd.

This report purports to compile and interpret data, based on the writer's personal work and observations, study of private company reports, and on researching publications. The writer wishes to acknowledge his appreciation and thanks to L. J. Manning, P.Eng., and H. M. Thurgood, P.Eng., for permission to use some of the data from their work to be included in this report and for the many helpful discussions and support given by L. J. Manning.

LOCATION AND ACCESS:

Approximate co-ordinate-Long. 147°46'W.
(property centre) Lat. 64°58'N
U.S.G.S. Fairbanks D-2 Quad, Alaska.

The property is 11 miles north of Fairbanks, Alaska, in Township 2 north, Range 1 west - Fairbanks meridian. It occupies Sections 15, 16, 17, the north half of sections 20, 21, 22, the west quarters of section 14 and the NW¼ and SW¼ of the NW quarter of section 23.

Fairbanks, with a population of 16,500, is maintained chiefly by the U.S. Military. It is well serviced by highways, railroads and has modern airport facilities catering to both intra-state and international traffic. Daily scheduled flights to Seattle are serviced by Alaska Airlines and Pan American Airways. The seaports at Anchorage and Seward are accessible to Fairbanks by both railway and highway. Rail distance to Anchorage is approximately 340 miles and to Seward 420 miles. The port of Valdez is 320 miles by road to Fairbanks. (See Map 1.)

Access to the property from Fairbanks is by travelling north for 11 miles on the paved Steese Highway to the settlement of Fox. The well maintained, gravelled Elliott Highway (in the process of being paved) leads westerly from Fox for a distance of 3½ miles to the Murphy Dome gravelled road turn-off. This latter road is maintained Year-round by the U.S. Military operating the Murphy Dome

DEW Line Station. The main workings of the No. 2 vein at 1800' elevation is immediately south of the Murphy Dome Road, and 3½ miles west, by road, from the Elliott Highway. The No. 1 vein workings are ½ mile north of No. 2 vein at 1100' elevation sited near the east fork of Eagle Creek. Total distance from Fairbanks to the No. 2 vein is 18 miles, 11 miles of which is paved. All roads to the property are maintained open year-round by the State or by the U.S. Military.

PHYSICAL FEATURES:

Elevations on the property range from 900 feet a.m.s.l. to 1840 feet a.m.s.l. The northern two thirds of the property are on northerly facing slopes while the southern third is on south facing slopes. The terrain consists of moderate to steep slopes, gently rounded ridges and domes rising to a maximum relief of 1840 feet just south of the No. 2 vein workings. Tributaries of Eldorado and O'Connor Creeks drain the southern part of the property while northerly drainage is provided by tributaries of Treasure Creek, Eagle Creek, Independence Creek, and Wildcat Creek.

Water supply from these tributaries are, at best, seasonal and are only adequate for exploration drilling purposes. The closest reliable milling water supply is at Fox, where water can be obtained year-round by drilling into the dredge tailings in the Goldstream Creek Valley. No survey for high continuous water flows has been made in the immediate vicinity of the property by this office and the foregoing comments are from casual observation only.

The property is characterized by a scarcity of outcrops. Permafrost conditions prevail. Government reports indicate that the gound is permanently frozen to an average depth of 160 feet. Locally, the north facing slope surface is covered by about 4 feet of permanently frozen black soil topped with moss and tree growth. On stripping the moss cover in the summertime, this black muck turns into a quagmire and thawing commences to appreciable depths. It takes at least one summer to dry the thawed material before it can be driven over without resorting to tracked vehicles.

The vegetation cover is typical sub-arctic boreal forest of the type found close to the tree line. Flora include a mixture of scrub conifers, birch, willow and buck brush. Some of the conifers are up to a foot in diameter and are judged suitable for mining purposes e.g. underground timbering.

CLIMATE:

Climatic conditions from late spring to early autumn are pleasant with low precipitation, long daylight hours and moderate temperatures. Cold temperatures prevail for the balance of the year, particularly from December to February where temperatures are often below zero with reported extremes down to -60°F. Average snowfall per year is less than two feet. Daylight hours in the winter are very short, thus any permanent surface plant would have to be thoroughly winterized to permit year-round operations. The mean annual precipitation is 12 inches with 63% of this from May to September.

PROPERTY:

The property has, at various times, been known under the following names:-

Scrafford Mine
Scrafford Property
Black Eagle Mines
Eagle Creek Mine
Scrafford Antimony Prospect.

In addition to the key claims optioned from the vendors, Cantu Minerals had staked additional claims to bring the aggregate to 84 contiguous mineral claims to date. The rectangular claim block is 3.25 miles east-west and 1.5 miles north-south aggregating 4.875 square miles or 3120 acres. Details of these claims are included in Appendix 1 of this report and are shown in Dwg. 3.

HISTORY AND PREVIOUS WORK:

A chronological summary of the history and previous work follows:-

1915 E.L. Scrafford leased a group of claims including the Chief and Sunrise from E. Quinn, one of the original owners. The Scrafford Antimony property or Black Eagle Mines was systematically developed in June, 1915, by a crew of 25 men. The deposit was worked by an open cut along the vein and by a 75 foot adit in September, 1915. Some stoping was done and a 20 foot shaft sunk. The antimony ore was hand sorted, then hoisted by a 3000 foot long cable tram to the top of the ridge-location of the present Murphy Dome road, and hauled by teams to the railroad for a distance of 4½ miles.

where it encountered the rails of the main adit.

When the antimony price declined in 1966, Silver Ridge ceased all operations on this property.

RECENT WORK:

Messrs. Ken O'Hara and Arley Taylor optioned the key claims to Cantu Mineral Association of Seattle on December 8, 1969. Terms of the lease option agreement are $400,000 for total purchase of the claims payable at 10% net smelter returns from newly mined and 25% from all stockpiled ore, fulfillment of all assessment requirements plus a payment of $5,000 per year to the vendors. The vendors further agree that all claims staked by them or on their behalf within a 3 mile radius of the key claims shall be subject to the same option agreement.

- On January 4th, 1970, Cantu obtained a concentrate sales agreement with Hibino Metals Industrial Corp., 3-Chome, Oimatsucho, Kitaku, Osaka, Japan, naming Oagitani, Kogyo Co. Ltd. of Japan as buyers. The agreement called for shipment of 3100 metric tons of antimony ore to commence in February, 1970, and to terminate in May 1970, after which time, a shipment schedule would be agreed to between parties up to April 30, 1971. A floor price of $7 U.S. per dry metric ton unit for 17% Sb scaling upward to $17.64 for 60% Sb ore or better was specified. One half of the difference between the floor price and the Metals Week (EMJ) quote would be paid for everything over the floor price. A copy of this agreement is included in Appendix 11 of the report. As shipments were not maintained, the agreement was terminated.

- Exploration work in 1970 consisted of 180 feet of underground crosscut in the No. 1 vein and bulldozer trenching and stripping on all known veins to establish the grade, physical characteristics and continuity. A total of 15 trenches were excavated. The No. 2 vein was stripped for 167 feet along strike. The work involved 36,770 cubic yards of excavation, 80% of which were in bedrock. During May and the early part of June an airtrack drill was required to assist in blasting the frozen ground. A D8 bulldozer equipped with rippers and a front end loader performed the excavations. All trenches were geologically mapped and, wherever required, channel samples were cut for assays.

In late July and early August, when the overburden had thawed sufficiently, a geochemical soil survey was conducted over the entire property along grid lines at 400 foot intervals. A stadia survey was completed to tie in all the workings. A preliminary metallurgical test was conducted by Pamicon Laboratory of North Vancouver.

Table 5 summarizes results of the exploration work to date.

PRODUCTION:

Recorded past production totalled 1500 tons of hand-cobbed ore shipped in 1926. There are no records on the 1915 production. Recent production from the property consisted of hand-sorting activity from the trenching operation and from dump material (stockpiles) near the No. 1 adit. This latter material appears to be the tailings or rejects of early high grading and screening operations. It consists of small particles, up to ½ inch, of relatively pure stibnite that average a consistent 12% to 16% Sb.

Recent shipment to Hibino Metals consisted of 62 tons of bagged antimony ore estimated at 60%+ Sb, and 323 tons of 12% to 16% Sb ore. A trial shipment of 120 tons of the 12% to 16% Sb ore was sold to National Lead Co. of Laredo, Texas. Total shipment was 505 tons. Sales to Hibino Metals were based on contract, whereas sales to National Lead were on open contract. Past production by Cantu is detailed and confirmed as follows - supported by Bill of Lading.

February 13, 1970	206,960 lbs	Japan
February 28, 1970	37,845 lbs	Japan
March 14, 1970	40,170 lbs	Japan
March 21, 1970	40,240 lbs	Japan
March 26, 1970	228,770 lbs	Laredo, Texas
April 28, 1970	238,050 lbs	Japan
June 29, 1970	487,210 lbs	Japan
June 30, 1970	277,390 lbs	Japan
Gross weight	1,556,635 lbs or 778.37 short tons	
Past shipments	778.317 short tons	
July, 1970	505.000 short tons	
Total to July, 1970	1283.317 short tons	

No settlement sheets showing grade have been made available to this office.

REGIONAL GEOLOGY

The geology of the area north of Fairbanks is best summarized by A. H. Brooks, who stated, "The larger features of the Fairbanks district are relatively simple, though detailed structure and stratigraphy are so complex that in view of the scarcity of outcrops they almost defy analysis." The predominate lithological unit is the Precambrian Birch Creek Schist Formation. Mesozoic dykes and stocks of granite, granodiorite and porphyry intrude the schist. The following simplified Table of Formations pertaining to the general area is adopted from the work of T.L.Pewe, et. al., and A.H. Brooks.

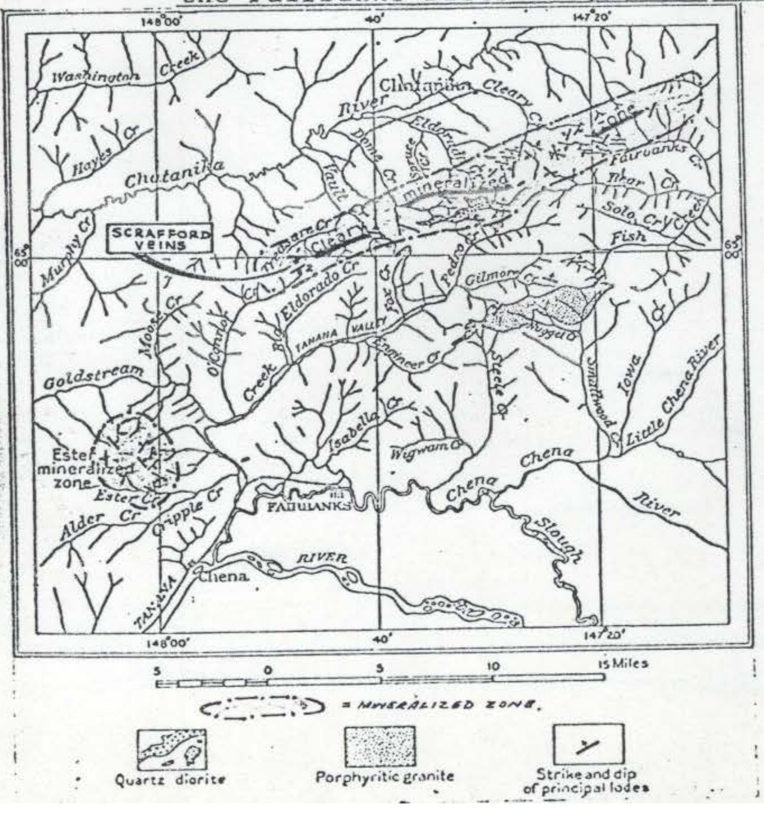
TABLE OF FORMATIONS

ERA	PERIOD OR EPOCH	FORMATION	LITHOLOGY
CENOZOIC	Quaternary		Fairbank Loess and perennially frozen silt.
	Tertiary	Coal-Bearing Series	Nenana Gravel -Poorly consolidated pebbly sandstone, claystone and sub-bituminous coal
MESOZOIC	Cretaceous Jurassic	Intrusive rocks	granite, granodiorite, diorite and porphyry
	UNCONFORMITY		
PALAEOZOIC	Mississippian	Totatlanika	Quartz-microcline-sericite schist and augen gneiss
	Devonian	Intrusive	Mafic and ultramatic rocks
	Silurian	Tolovana	Mainly limestone
	UNCONFORMITY		
PRECAMBRIAN	Early Precambrian	Nilkoko	-chert, siliceous shale, grit argillite, quartzite and limestone
		Birch Creek	-mainly quartz-sericite schist, micaceous quartzite, and quartzite.

At least two stages of deformation and recrystalization are indicated for the Birch Creek Schist, the first probably of higher metamorphic grade than the second. Metamorphic grade is middle, almandine-amphibolite facies, near Fairbanks and decreases northwestward to the lower grade greenschist facies. Contact metamorphic zones are well developed at the borders of intrusives. The Birch Creek Schist is folded regionally. Earliest folds trend northwesterly but later structural trends are northeasterly. Locally, the rocks are folded into closely spaced isoclinal and symmetrical folds having amplitudes of tens of feet. The larger granitic stocks trend from N70°E to east and are believed to be intruded parallel to the original regional structural trend.

Nearly all metalliferous veins of the Fairbanks district are found in the Birch Creek Schists, often near the intrusive. Mineralization consists mainly of stibnite and gold quartz vein deposits. Two mineralized zones (see Fig. 1) are recognized in this district. The Cleary Zone has an extreme width of 2 miles at the head of Cleary Creek and has been traced for about 20 miles in a N70°E trend. Where mineralization is strongest the area is intruded by numerous granitic dykes. The Ester Mineralized Zone is roughly 2½ miles in diameter and is approximately centered on Ester Dome. Its mineralization is similar to the Cleary Zone. Gold placer deposits in parts of the Fairbanks district are attributed to these two zones.

FIG. 1 - Antimony Mineralized Zones of the Fairbanks District. (after Brooks)



PROPERTY GEOLOGY

The property area is characterized by a scarcity of outcrops. Consequently, all the geology mapped is confined to exposure excavated by bulldozer trenching and stripping. Members of the Precambrian Birch Creek Formation are the only rock types exposed. Locally, they are folded into a series of anticline and syncline with amplitudes of tens of feet.

The Birch Creek Schists are formed by synkinematic metamorphism of shale, siltstone and limestone. T. Pewe reported that at least two stages of deformation and recrystallization are indicated. The property area belongs to the lower grade greenschist metamorphic facies. Isotopic age dating gave a range of 570 m.y. to 1170 m.y. (Wasserburg, et. al., 1963) to the Birch Creek Schist thus assigning its age to Precambrian or Early Palaeozoic.

Strong shear zones, one of which has been partially traced for 3000 feet in strike length, traverse east-west and northeasterly across the property. Stibnite lodes are localized within sections of these shears where structural and lithological conditions are favorable for their deposition.

LITHOLOGY

U.S.G.S. mapping shows two small Mosozoic granitic stocks intrude the Precambrian Birch Creek Schists at Section 16 and 17. One lies ¼ mile northwest of the No. 2 vein, midway between the No. 1 and No. 2 veins; the other is 3/4 mile west of the No. 2 vein. Both stocks are elliptical in shape and measure ¼ mile on their major axes. The intrusive is grey when unweathered and brown on weathered surface. It is a medium grain prophyritic granite.

Members of the Birch Creek Schists are dark grey, reddish-brown to tan weathering schists. They are predominantly quartz-sericite schists and quartzite. Black chloritic and graphitic schists, talc and sericite schists are less abundant. The rock occurrences are intermixed intercalated beds, varying from narrow interbeds of all schist types a few inches thick to differentiated beds over a hundred feet thick. Quartzite and graphitic schist beds are generally useful marker horizons. Within this succession of interbeds, the schists are all highly foliated and locally may exhibit wrinkled lineations, innumerable crenulations and small drag folds. Irregular masses and boundinage of white quartz in small fractures, between schist layers, in dragged and crenulated zones, and along bedding planes are locally widespread (See Drawing 10 - Trench 24 west wall).

Quartz-Sericite Schist:

The quartz-sericite schist exhibits pronounced schistosity and where dragged, crenulated or crushed often contains stringers, masses and boudins of white quartz. It is dark green or mottled yellowish grey and has a silvery lustre when wet. Where it occurs as wall rocks adjacent to stibnite veins it is hydrothermally altered and coated by maroon hematite.

Quartzite:

The quartzite unit mapped is mineralogically more a micaceous quartzite than a pure quartzite. The quartzite is fine to medium grained, buff to grey or white in colour. It has a gneissoid to schistose mosaic texture. The quartz grains are often bordered by sericite flakes and wisp and carbonaceous material. Some white quartzites are intercalated with relatively pure quartz, laminae of quartz and sericite or quartz, sericite and carbonaceous minerals. Bedding within the quartzite unit are usually obliterated by much jointing resulting principally from folding and faulting.

The quartzite occurs as interbeds throughout the Birch Creek Formation, sometimes it is concentrated in well defined separate bands. Both thick and thin bedded varieties are represented. The thick-bedded variety is from two to tens of feet thick. The one exception being a very thick bed near the No. 1 Vein. This bed has been partially exposed for 150 feet in thickness. The top and bottom of the bed i.e. its full thickness, has not yet been determined to date. The thin bedded variety is composed of beds varying from a few inches up to two feet thick. All thin bedded variety, at times, is contorted, warped and drag folded. Thin bedded quartzite bed occur as regular alternating interbeds intercalated with proportional or lesser amounts of quartz-sericite schist as characterized by the No. 2 and No. 4 vein areas. Where thin bedded quartzite exceed quartz-sericite schist in proportion, this combined mixture is referred to as "quartzitic schist". In the No. 1 Vein area quartzite is subordinate to quartz-sericite schist with the exception of the thick quartzite bed noted earlier.

"Quartzitic Schist":

Thin bedded quartzite are often interbedded with quartz-sericite schist and other schists. Where the quartzite interbeds occur in greater relative abundance, greater than 60%, this intermixed rock unit, for convenience, is referred to as "quartzitic schist" e.g. No. 2 Vein area.

Graphitic, Talc and Sericite Schist:

Graphitic schist occurs infrequently. It forms thin laminae, up to a few inches thick, interbedded with the quartzite and quartz-sericite schist. It is black or greyish black exhibiting a dull to bright sheen when wet. The texture is schistose with interalced laminae, strands and wisps of graphite and sericite enclosing quartz, carbonate minerals and sericite. Being very plastic it is generally easily contorted, crenulated and drag folded near fault zones (e.g. see Drawing 13 - Trench 31 east wall). Talc schist is light grey to white and is analogous to the graphitic schist in characteristics. Sericite schists occur as thin laminae, a fraction of an inch thick, interbedded with other schists.

Both quartz-sericite schist and quartzite are intensely hydrothermally altered when they act as wall rocks of stibnite deposits. Maroon coloured hematization, especially in the quartz-sericite schist forms a wide outer halo for tens of feet beyond this intense alteration.

Within the seasonably thawed layer, the quartz-sericite schists are "exfoliated" into thin separate sheets by frost wedging and heaving, with attendent down slope migration through solifluction and gravity flowage. The more massive and competent quartzite yield large semiangular blocks from this process.

STRUCTURAL GEOLOGY

According to U.S.G.S. mapping (Pewe, et. al.), the property is traversed by northeasterly trending folds with fold axis spaced at approximately one mile apart. Structurally, the mapped area is complex in smaller scale folding and faulting. The structures in the No. 1 and No. 3 vein area differ slightly from that at the No. 2 and No. 4 vein area. Where faults or shear zones intersect quartzite bedding conducive to maximum rupture stibnite lodes are formed.

Faults:

Strong east-west and northeasterly striking gouge filled shear zones up to 50 feet wide of normal fault movements and narrower parallel to subparallel faults and cross-cutting transcurrent and thrust faults traverse across the property. A cylindrical fault occurs in Trench 24. Veins uncovered in Trenches 24 and 41 are offset for a few feet by a low angle thrust fault and a cylindrical fault. These were the only incidences encountered where faults have displaced the veins.

The No. 1 and No. 3 vein area:- an east-west striking shear zone dipping from 50^o-65^o south has been traced for a strike length of 3000 feet by 12 trenches spaced at various intervals. Where exposed, it varies from 5 to 50 feet wide. Another smaller shear zone from 2 to 5 feet wide runs parallel to and is from 20 to 40 feet north of the main shear. Locally, several smaller parallel faults occur on either side and between both shear zones. The main shear zones and other narrow parallel faults are gravity faults. The smaller shear to the north is a reverse fault. Net-slip based on graphitic schist and quartzite beds is estimated to be no greater than 80 feet. Evidences supporting gravity fault movement include slikensides, displacements of marker beds, appropriate flexure direction of plastic schist beds, crenulation and development of drag folds in the more plastic graphitic and quartz sericite schists along fault planes, lensoid quartz boudinage and elongated, stretched lenticular breccia fragments. (See Drawing 16, Trench 33.) The shear zones have well defined walls that confine a body of breccia and varicoloured gouge. The matrix is composed of a mixture of light coloured kaolin and talc, grey to black carbonaceous, graphitic clay gouge, iron stain brown to maroon hematite-limonite clay, quartz boudin, calcite patches and stretched lensoid breccia of variable sizes. Superimposed onto the clay gouge are limonite and hematite encrustation, streaks and smears. In the No. 1 vein area, the footwall is characterised by a six inch to two feet wide hydrothermally altered band of intermixed white, light yellow, and pink kaolin, silicification, white quartz patches and yellowish limonite. The hanging wall is usually composed of a narrow 6 inch to 1 foot band of sheared and pulverulent graphite. The gouge is segregated into distinct alternating and parallel coloured bands of clay products conformable to the dip of the shear zones. These consist of light grey to black carbonaceous clay bands alternating with, light coloured kaolin, brown to maroon hematitic gouge and yellowish limonitic gouge. Within each band stretched lensoid breccia, calcite and quartz lenses varying from pebble size up to a few feet long are common. (See Drawing 20 & 21.)

Country rocks occurring between closely spaced shear zones and parallel faults are locally sheared crenulated and drag folded. Bedding in the thicker and more competent quartzitic beds are often obliterated by intense fracturing. Areas between the two main shears locally contain numerous small antithetic faults, bedding faults and tension fractures. These are probably secondary features derived from deformation during development of the shear zones, faulting and folding.

where the shear zones intersect quartzite at an angle conducive to rupture, stibnite lodes are formed. The No. 1 lode is thus localized for an exposed strike length of 220 feet in the main shear. A smaller lode is found in Trench 31.

The No. 2 and 4 veins occur in two distinct shear zones. Both shear zones have gravity fault movement. They strike 45° to 55° and dip 55°-65° south. In contrast to the No. 1 and No. 3 vein shear, both these shear zones are fairly uniformly mineralized by stibnite in all exposures. The stripped area and Trench 23 disclosed that the lode is contained in a well defined gouge filled shear that pinches and swells from 3 to 12 feet wide. In the No. 2 vein, between the footwall of the lode and the hanging wall of a parallel fault to the north, the country rock is silicified, moderately sheared and fractured containing little or no clay gouge but abundant limonite, hematite and wisps of kaolin. This larger zone of shearing, inclusive of the lode, is from 6 to 20 feet wide. Varicoloured clay gouge is not as pronounced as in the No. 1 and No. 3 vein areas. Segregated coloured gouge bands are not apparent. Here, white kaolinized and black carbonaceous gouge generally host better grade stibnite mineralization whilst the iron stained gouge carry weaker mineralization. (See Drawing No. 9 and No. 19.)

Cocoa coloured, hematite dominant, shear zones characterize the east wall of Trench 41, the west wall exhibits a sheeted zone with several crosscutting low angle thrust and gravity faults. The lodes are offset for a few feet by two such faults. Similarily, Trench 24 exposed two well defined lodes, tentatively called No. 5 and No. 6 veins. The trench walls contain abundant quartz patches and boudin and gravity and thrust faults. Two low angle faults offset both veins for a horizontal distance of 6 feet. It should be emphasized that crosscutting faults in Trenches 41 and 24 are the only instances encountered where the lodes have been displaced by faulting. As in the No. 1 vein area secondary structures like antithetic faults, tension joints, etc. are present in this area.

In all shear zones the gouge surfaces show recurrent movements have taken place. Slips and fractures abound throughout the gouge zone, some are parallel or subparallel to the wall and others are omnidirectional.

Folds:

The No. 1 vein area exhibits symmetrical folds trending east-west. The main shear zone is approximately coincident to the fold axis of an anticline. The axes of a syncline and another anticline are sited 30 feet and 60 feet respectively to the north. The axial planes dip 55-65° south and the folds plunge 30-35° west. (Drawings 20 and 24.) Folding in the No. 3 vein area is similar except that folds plunge 5-20° east. Since the amplitudes of folds are only tens of feet, it seems likely that they could represent drag folds in the limbs of the large nearby regional anticline mapped by the U.S.G.S. The fold symmetry is the result of deformation culminated from compression and a couple combined and accentuated by later movements of the two shear zones.

In the No. 2 and 4 vein area, a broad east-west anticline plunging 10°-15° east is indicated. The mechanics of folding resembles that of the No. 1 and No. 3 vein areas.

Non-Diastrophic Structures:

These structures are caused by solifluction combined with downslope gravity flowage. Permafrost conditions prevail in the area and are reported to extend an average of 160 feet beneath surface. The seasonal summer thawed layer (active layer) is 20-25 feet from surface. Within this layer superficial non-diastrophic structures can develop where the slopes are as low as 2°.

In permafrost terrain, progressive downslope gliding movement, mainly by viscous flowage of water saturated waste i.e. solifluction, is a more important and rapid process than normal gravity hill creep. Frost wedging along bedding planes and fractures, from seasonal thawing and freezing, results in poorly consolidated rocks in the active layer. The underlying frozen ground is impervious to water. The active layer is saturated by the thawed water produced. Rocks in this semiaqueous active layer resting on frozen ground promotes rapid plastic flow and glide down the flanks of elevations into troughs. Active layer gliding usually results from thaw failure of the ice-rich contact zone. The rate of glide is directly proportional to the steepness of hill slope and the thickness of vegetation; since the latter controls the relative temperature gradient.

In the active layer attitudes of bedding, other structures and veins are all distorted. This distortion is locally called "permafrost drag". Structural measurements obtained near surface can be very misleading in rocks affected by this process. In addition to drag structures, flap, cambers, "dip-and-fault", slump structures and flexure slip fold are formed. These are distinguishable in many of the trenches mapped. Figure 2 is an idealized diagrammatic sketch illustrating this phenomenon. (also see Plates E1-E3.)

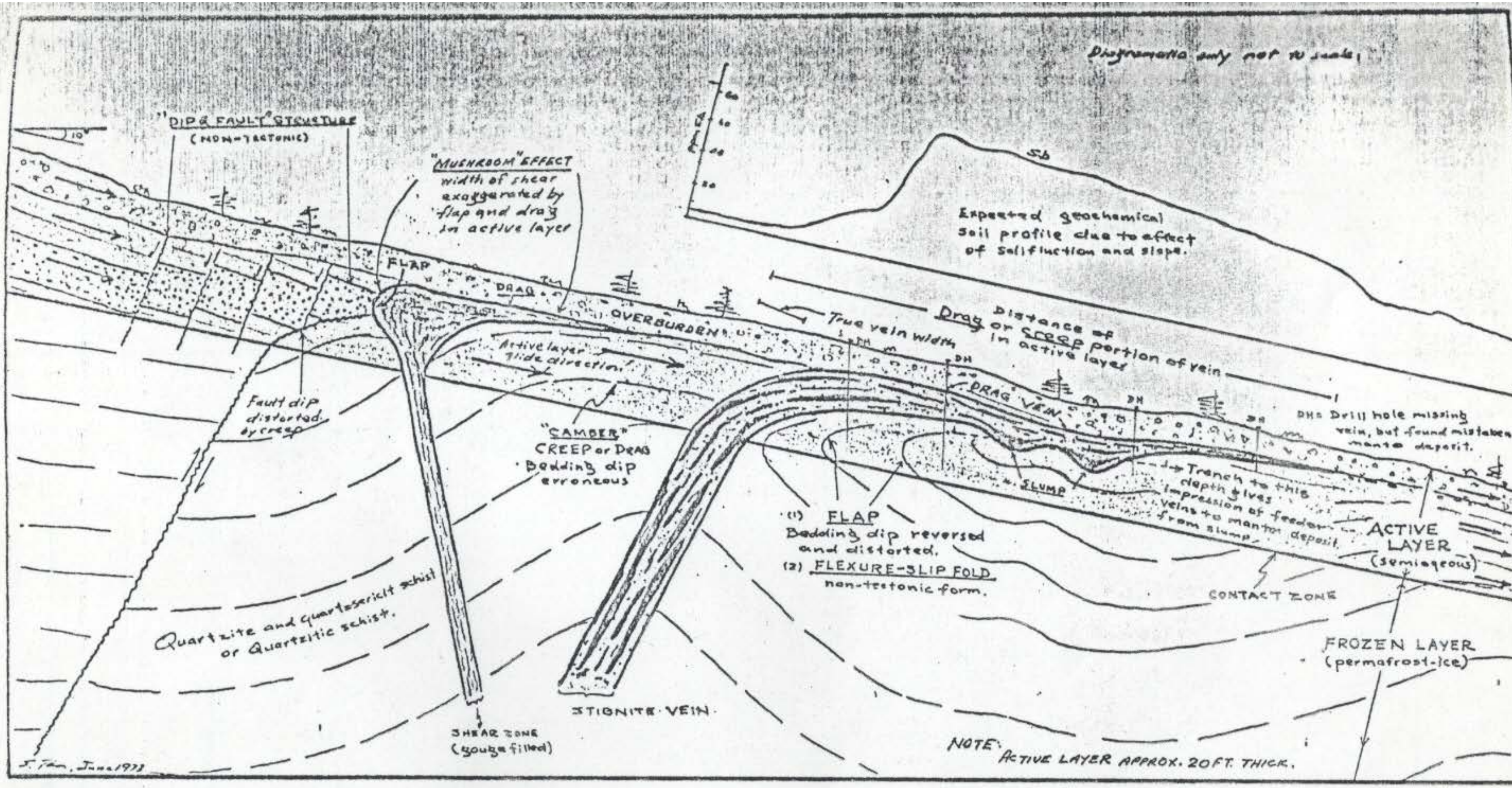


Figure 2 - Diagramatic section showing non-diastrophic structures. Active layer glide via solifluction and gravity flowage. Its effects on geological interpretation and on exploration due to distortion of geologic struc -tures in the active layer are illustrated.

The end results of the solifluction process and its profound effects on exploration and geological interpretation within the active layer include:-

(i) Distortions of vein, shear zone, faults and bedding configurations. For example, a vein or shear dipping steeply upslope would, in the active layer, appear conformable to the gentle slope or appear semi-horizontal. Similarly, a vein dipping downslope would have an exaggerated width at its apex - a "mushroom like" effect, caused by slippage resulting in formation of a flap followed by a long drag, (See Drawing 17 Trench 5.). A good example is shown in Drawing 21, Trench 6, where a 15 foot shear zone dipping 60° upslope has been dragged and stretched to a 15° dipping, 150 foot length of shear zone material in the active layer. Depending on the hill slope steepness, the stibnite lode found in the active layer may be distorted and displaced tens of feet to over a hundred feet from its actual location beneath the active layer. This can also be mistaken for a manto deposit rather than a vein. Bedding and other structures are similarly affected. Thus attitudes of geological structures measured in the active layer are erroneous and often useless unless they can be correlated to the real attitudes occuring below the active layer. This necessitates cutting deep trenches, at least 20 feet deep in the property, to below the active layer in order that the true characters of all structures can be accurately measured and recorded.

(ii) Geochemical soil suvey results require special interpretation techniques due to the effect of drag. Soil anomalies would occur in a much broader zone downslope than that where solifluction is absent. The vein and drag both contribute to the anomaly. Contribution by the drag predominates over the vein portion since the drag lies closer to surface along the bottom of the overburden layer. The undragged vein lies further from surface because of its curvature on entering the active layer. Under these conditions, the broad soil anomaly even taking downslope migration into account, may be interpreted to be derived from a stratiform or manto deposit or a series of closely spaced parallel veins rather than from a single much narrower vein deposit.

(iii) Test drilling based on near surface exposure only, would reveal a thin manto deposit conformable to the hill slope rather than a narrower steep dipping vein, and could miss the vein completely. This is especially true on this property where geophysical methods, i.e., E.M., Turam, self-potential, I.P. are not expected to be definitive enough to pinpoint the vein material, due to the relatively poor conductivity of stibnite and an abundance of other better conducting materials like graphite, clay gouge and micas.

(iv) Shallow trenching on the "drag" portion of the vein would reveal an exaggerated vein width which can be mistaken for a manto or stratiform deposit. When drag-vein materials slump into troughs and depressions, insufficient trench depths can cause a mistaken interpretation that the slumps are feeder veins to a manto deposit or that there are more than one vein, when actually only one exists. (See east wall of Trench 6-Dwg. 21).

(v) Development of superficial non-tectonic drag structures, dip-and-fault, camber, flap, flexure-slip folds, and slump structure in the active layer can lead to erroneous geological interpretation of the actual tectonic events.

It is apparent from the foregoing that to obtain a true representation of the geologic setting, it is imperative that trenches be excavated to depths beyond the active layer. It follows therefore, that in geolocial, geochemical, geophysical, trenching and drilling exploration efforts, due considerations should be given to and cautious interpretations taken on the effects of these non-diastrophic structures in the active layer.

ECONOMIC GEOLOGY

Mineralization consists of stibnite lodes occurring within strong shear zones. Exploration work was concentrated on two main lodes named the No. 1 vein and No. 2 veins, four other lodes, the No. 3, 4, 5 and 6 veins were exposed by trenches. Work to date revealed the presence of 297 tons per vertical foot, at the surface, grading 11.3% Sb over an average true width of 8.0 feet, in situ, for the No. 1 and No. 2 veins combined. The geochemical soil sampling results indicate that several other potential mineralized zones, some of equivalent or greater magnitude than the No. 2 and 4 veins, exist on the property. Geologically, these deposits are remarkably similar in many respects to the Chinese Hsikwanshan type deposits, which at one time were the chief antimony producers of China and the world.

Antimony is the main metal of economic interest. Minor gold and silver values are associated with the mineralization. Lead generally assayed trace amounts, arsenic ranges from 0.1% to 0.8% averaging 0.3%. Such low lead and arsenic contents are generally regarded by antimony smelters as desirable ore and are normally not subject to the usual penalties.

MINERALOGY

Stibnite (Sb_2S_3) and its oxidation products are the chief antimony minerals. Stibnite is economically the most important mineral followed by cervantite, stibiconite and lesser amounts of kermesite. Gangue minerals, in order of decreasing abundance are: kaolin , quartz, sericite, hematite, limonite, calcite and graphite.

Stibnite:

Stibnite is lead grey and has a dark blue sheen when wet. It occurs in a variety of forms. Some are in fine granular aggregates intermixed with fibrous masses or acicular crystals. Fine to medium grain disseminations occur on the periphery of large massive pods or as independent aggregates. Another type consists of a random concentration of coarse acicular crystals with some showing a radial grouping. Massive stibnite is composed of fine to coarse columnar crystals interspersed with fibrous and granular aggregates. A little vitreous quartz is embedded in most of the stibnite pods. This intergrowth of quartz is probably the impurity which reduces the grade of the seemingly pure stibnite.

Stibnite Oxidation Products:

The oxidation products of stibnite recognized to date are the hydroxide-stibiconite, the oxide-cervantite and the oxysulphide-kermesite. Other oxides like valentinite and senarmontite are probably present but have not been definitely identified. Cervantite and stibiconite are the chief oxidation products, kermesite is minor. They occur most often within 20 feet of the surface and are probably confined to a zone of oxidation of less than 75 feet from surface. For example, a marked reduction in these secondary minerals is obvious among stibnite mineralization in the No. 1 Adit, which lies 40 feet below surface. Near surface, the smaller stibnite grains are completely oxidized. The oxidation products form incrustations ½ inch or more thick around stibnite grains and masses and as coatings in fractures within the stibnite. The various antimony oxides almost invariably are intergrown with one another and definite and complete crystal forms are not developed.

Cervantite is pulverulent or massive, white to yellow in colours. Stibiconite is canary yellow and mostly amorphous, varying from pulverulent to massive and compact. Kermesite is cherry red, and normally forms the first envelope, usually a fraction of an inch thick, around stibnite. Its usual forms are in tufts and specks. It is most abundantly found in moisture saturated areas. Kermesite is regarded as an intermediate alteration product which, upon further oxidation, may change to cervantite or valentinite.

Table 1. summarizes some of the main characteristics of these antimony minerals. (Also see Plate A-1 and A-2).

TABLE 1: ANTIMONY MINERALOGY AT THE SCRAFFORD PROPERTY

Mineral Class	Name	Formula	Antimony Percent	Specific Gravity	Colour and Form	Mode of Occurrence
Sulphide Sulphide	Stibnite	Sb_2S_3	71.7	4.5-4.6	lead grey, granular acicular, massive, columnar.	Hypogene
Oxide Oxide	Cervantite	Sb_2O_4	78.9	4.08	yellow to white pulverulent to massive.	Supergene
	*Valentinite *Senarmontite	Sb_2O_3 Sb_2O_3	83.3 83.3	5.76 5.3	white. colourless to grey.	Supergene Supergene
Hydroxide	Stibiconite	$Sb_2O_4H_2O$	74.5	5.1-5.3	Canary yellow amorphous pulverulent to compact.	Supergene
Oxysulphide Oxysulphide	Kermesite	$2Sb_2S_3Sb_2O_3$	75	4.5-4.6	Cherry red, tufts and specks.	Supergene

* Valentinite and Senarmontite may be present but have not been definitely identified to date.

Gangue Minerals:

Quartz is the most important gangue mineral. Small vitreous quartz grains impregnate the stibnite and larger quartz patches are found between the stibnite pods. Some of the vitreous quartz grains are euhedral but most are anhedral. Fine grain vitreous quartz are often inter-mixed with what looks like pure stibnite. Quartz veins proper are not evident but large irregular patches and occassional lenses inter-mixed with stibnite are common. Two generations of quartz are recognized, the older is white and the younger vitreous.

The other gangue minerals; kaolin, hematite, limonite, sericite, calcite and graphite are constituent minerals of the shear zone matrix, collectively forming the gouge material.

VEIN SYSTEMS AND DISTRIBUTIONS

Stibnite mineralizations are found in sections of strong shear zones discussed earlier. Where these shear zone sections are mineralized with stibnite, they are called veins or lodes. The most desirable vein loci are at the intersection of shear zones, at favourable angles, with thick-bedded quartzite or quartzitic schist. The veins are in gouge filled breccia zones or sheeted zones or transitions between the two types. Narrow parallel faults and joints adjacent to the veins occassionally contain some stibnite. All veins have well defined walls.

Slips and fractures abound throughout the gouge zone indicating recurrent movements have taken place.
In the No. 1 vein these are mainly parallel or subparallel to the vein walls. However, in the No. 2 vein some are conformable with the vein walls but most are omni-directional. (See Drawing 15, section A-B and C-D.)

The No. 1 vein contains the best stibnite mineralization. Trenches have exposed a 220 foot portion of its strike length. The No. 2 vein has been stripped 167 feet along strike. The No. 3 vein was encountered in one trench only; it occupies the same shear zone as the No. 1 vein. The No. 4 vein was uncovered in Trench 41. Veins No. 5 and No. 6 were exposed in Trench 24. Within the thaw-layer all veins exposed to date are distorted by non-tectonic processes via the active layer glide.

No. 1 Vein: See Drawing 7, 20, 21, 23 and 24, and Plates B.

Edward Quinn discovered the No. 1 vein and leased it to E. L. Scrafford in June, 1915. The deposit was worked by an open cut and a 75 foot long adit along the vein. There are no records of this production. The management reported that the highest precious metal assays obtained were 0.19 oz. gold and 0.8 oz silver per ton. Development, doubtless, was spurred by the rapid rising antimony price from 9 cents a pound in 1914, to 24 cents a pound in June, 1915, and peaked at 30 cents a pound in December, 1916. The gold and silver contents could also be a complimentary contributing factor. R. C. Wood extended the tunnel a further 300 feet and shipped 1500 tons of hand-cobbed ore in 1926. His efforts, likewise were inspired by the high 18 cents per pound antimony price in mid 1925, which rose from a low of 5 cents a pound in 1922. Recent shipment by Cantu totaled 1283 tons of hand sorted ore and lower grade stockpiled material mostly from the No. 1 vein.

The No. 1 vein has been partly exposed for a strike length of 220 feet by four trenches (Trenches 2-5). It occurs within a regional shear zone which has been traced by trenching for a strike length of 3000 feet. The vein is confined to where this shear zone intersects a thick quartzite bed along or near the crest of an anticline that plunges 30-35^{o} west. It has also been explored by a 180 foot cross-cut adit that terminated in the middle of the vein, 50 feet below surface. Work to date indicates this 220 foot section contains, in situ, 215 tons per vertical foot (@ 11 cu. ft.) of 13.5% Sb across an average true width of 9.3 feet at surface.

The vein strikes 85^{o}-95^{o} azimuth and dips from 55^{o}-60^{o} south. It pinches and swells from 4 feet to 19 feet and is confined to the footwall side of the shear zone, which here ranges from 6 to 38 feet wide. About one half of the width of the shear zone contains the vein material. The shear zone footwall is also the vein footwall. In the exposed vein area the hanging wall of the shear zone is in incompetent quartz-sericite schist while the footwall is in a thick bed of competent quartzite. Wherever appropriate angles of intersections between the shear zone and competent quartzite promote maximum rupture, the resulting open spaces so developed, accomodate the stibnite mineralization. A 20 foot wide incompetent quartz-sericite interbed within the quartzite, near Trench 5, constitutes the weakest mineralized section of the vein. The mechanics involved are discussed later under structural controls on stibnite deposition.

Stibnite occurs in lenses and pods of variable sizes, as parallel streaks and bands, stringers and fine to coarse grain disseminated aggregates. It is distributed among the clay gouge and is also associated with quartz along the footwall. The richest shoots are large massive podiform stibnite, with their long axes parallel to the vein strike. These large shoots are separated by quartz patches and other gangue intergrown with stibnite grains and smaller pods. The largest shoot exposed is 80 feet long and averages 2½ feet wide. Another partially exposed lenticular, massive and almost pure stibnite pod, east of Trench 2, measured 30 feet long and averaged 3½ feet wide. It trends toward the hanging wall of the shear zone. This suggests that the top of the faulted extension of the quartzite bed could appear in this area of the hanging wall; i.e. the estimated net slip would be approximately 80 feet. Seemingly pure stibnite invariably contains some vitreous quartz intergrowth which is partly visible and, in part, is recognizable only with the aid of a hand lens. Stibiconite, cervantite and minor kermesite encrustations are associated with stibnite near the surface. A marked reduction of these oxidation products is apparent in the vein at the face of the adit 50 feet below surface.

The vein is open along strike both to the east and west. Its near surface western extension will be limited to the top of the quartzite bed, estimated to lie 60-100 feet west of Trench 5. The eastern vein strike extension, near surface, will be limited and dependent upon the extent and thickness of the quartzite bed. Vein strike extension to the east is inferred to be a possible 400-500 feet from the current vein exposure. Based on the foregoing, the possible strike length of the No. 1 vein is estimated to be a minimum of 580 feet and a maximum of 820 feet or an average of 700 feet near surface i.e. can be exposed by trenching. The strike length at greater depth is a function of the quartzite thickness and lateral extent plus suitable structural conditions between the quartzite and the shear zone. Recurrence or absence of similar conditions at depth are also important criteria.

The depth extension will be controlled by the thickness of the quartzite bed, or extended beyond by recurrence of additional quartzite beds or quartzitic schists.

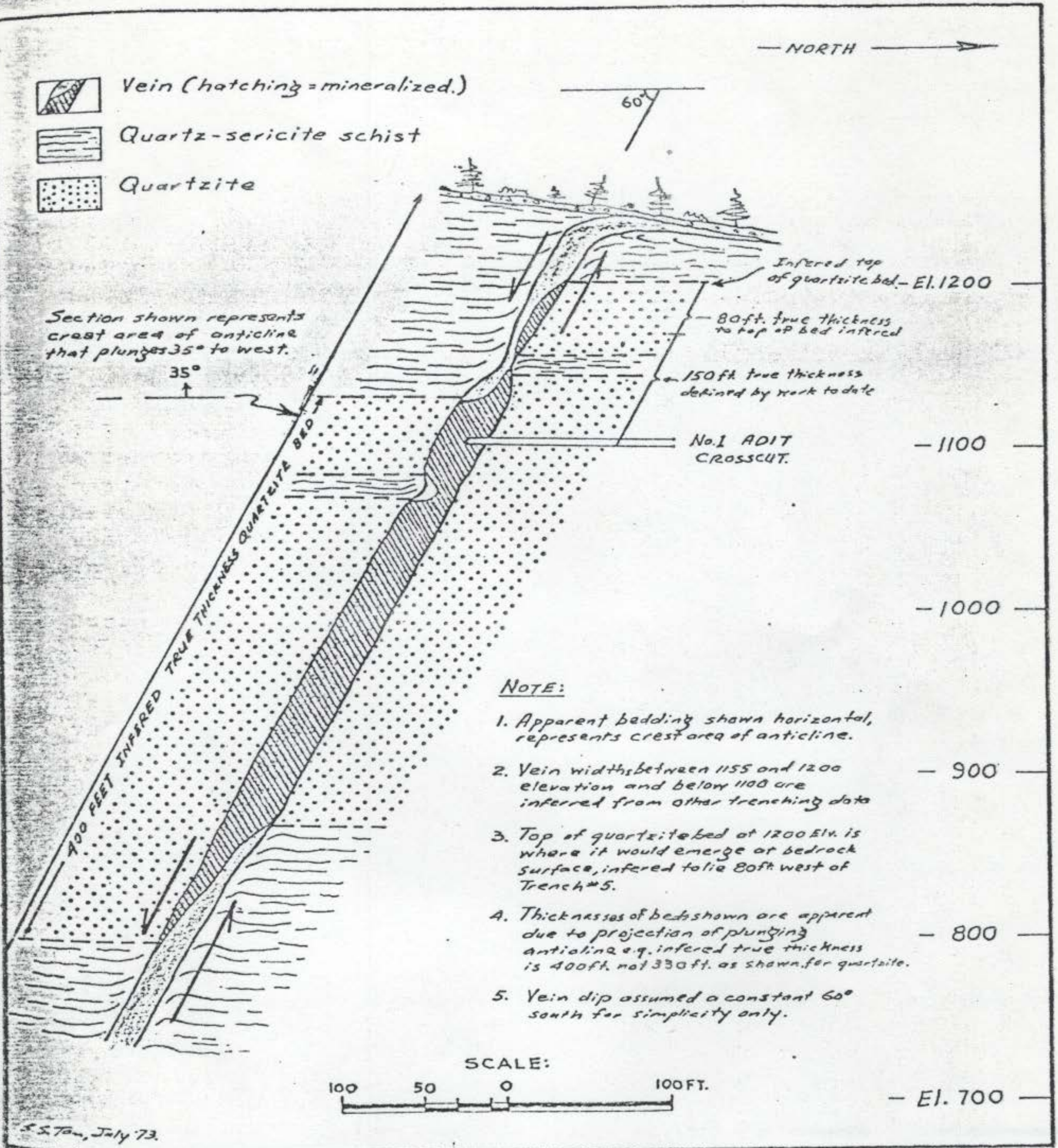


Fig. 3 - Hypothetical composite vertical section of No. 1 Vein. Sketch shows postulated depth extension of vein. Note effect of shear movement on quartzite bed and resulting distribution of minera -lization. Section based on inferred 80 feet net slip of shear zone and inferred 400 foot thick quartzite bed.

Applying the indicated 80 foot net slip for the shear zone, the area just east of Trench 2 would have quartzite on both sides of the shear zone; which here is also coincident to the anticline axial plane. Thus, a zone of wide stibnite mineralization extending across the shear zone to both walls would occur. Below this it is inferred that the vein would be localized on the hanging wall side of the shear zone since only the quartzite bed is present here, i.e. assuming no recurrence of other thick quartzite beds or quartzitic schist lie below the bottom of the quartzite bed on the footwall side. Fig. 3 illustrates this hypothesis.

<u>No. 2 Vein</u>: See Drawings 9, 7, 19, 25 and Plates C-1 to C-6

The No. 2 vein was discovered accidentally in 1964 by Silver Ridge Mining Co. when the bulldozer was making a turnout for supply storage. The exposed vein was reported to assay 25.8% Sb across 3 feet. A 35 foot test shaft was sunk on it. No further work was done when the slump in antimony price curtailed all operations in 1966.

During late May, 1970, the writer decided to expose the vein along strike in order to assess and map in detail the characteristics of stibnite distribution and mineralization along strike in at least one of the veins. The vein was stripped along strike for 167 feet. This section contains 82 tons per vertical foot of 5.45% Sb across an average true width of 4.65 feet, in situ. Visually, the mineralization is distributed consistantly throughout this length. This is further attested to from the 19 channel samples taken along the vein, which returned assays ranging from the weakest spot of 1.09% Sb across 5.5 feet to the strongest at 12.81% Sb across 9.0 feet. Part of the southwestern extension of the vein was uncovered at 180 feet from the western limit of the stripping in Trench 23. Thus, 347 feet of strike length have been confirmed to date. Five combined channel samples taken from both walls of Trench 23 returned 2.77% Sb across an average true width of 4.3 feet.

The vein strikes 45^{o}-55^{o} azimuth and dips 50^{o}-65^{o} south. It has well defined sinuous walls, vein widths pinch and swell from 2 feet to 12 feet. The vein is distributed in a gouge and breccia shear. Stibnite and its oxidation products may occupy any portion of the shear zone, unlike the No. 1 vein which is confined to the footwall side half of the shear. Furthermore, large quartz patches or veinlets are not apparent in this vein as it is in the No. 1 vein. The vein is in "quartzitic" schist. The quartzitic schist forms a broad anticline that plunges 10° east. The vein is adjacent to and, at time, coincident with the anticlinal axis. Consistent antimony mineralization within the vein is attributed to the competent quartzitic schist being intersected at a favourable angle by the shear zone. Recurrent movements had taken place within the shear zone as evidenced by numerous omnidirectional fractures and slips on the gouge surfaces.

Stibnite occurs as granular aggregates, streaks, pods and lenses. Finely disseminated stibnite and its oxides are distributed throughout the vein zone. The gangue, other than fine grain vitreous quartz, is divisible into four types:

(a) Intermixed white kaolin and black carbonaceous clay:- usually containing the best stibnite mineralization.

(b) Yellow to maroon hematitic and limonitic clay gouge:- often with lesser but sometimes equal amounts of stibnite and oxides as (a).

(c) Iron-stained brecciated and sheared rocks:- silicified and partly kaolinized; limonitic and hematitic, minor antimony mineralization.

(d) Talcose, graphitic and micaceous clay gouge:- occurring at the footwall or hanging wall only, no antimony mineralization.

Stibnite and its oxides are usually preferentially concentrated in types (a) but may be found from types (a) to (c) or a mixture of all three. Weaker parallel and branch faults on the hanging wall side occassionally contain minor stibnite. The stibnite lenses and stringers are parallel to the vein strike. The two largest stibnite lenses exposed are 20 and 25 feet in length respectively. Their widths range from a few inches to two feet. Vitreous fine grain quartz are intergrown with the stibnite. Much stibiconite and cervantite occur near the surface.

The vein is open along strike at both ends. The north-easterly extension could reach the vicinity of Trench 41, where similar lithology and mineralization was encountered in the No. 4 vein. Based on this, the No. 2 vein is estimated to have a probable strike length of a least 1000 feet. Greater strike length would be dependent on continuously maintained favourable lithological and structural conditions. Based on the known geologic factors, elevations of trenches and depth of the prospect shaft, the No. 2 vein has an assured and probable depth of 200 feet. (See Drawing 25). Greater depth extension is unknown at present, again this is subject to favourable geologic conditions. It is interesting to note that the highest exposed section of No. 2 vein (Trench 23) is at 1815' elevation and the lowest No. 1 vein exposure is at 1100' elevation for a vertical difference of 715 feet in height. This suggests that if favourable geologic conditions are maintained, and taking the depth as half strike length, the No. 2 vein is estimated to have a possible depth of 500 feet.

Other Veins: No. 3, 4, 5, and 6 veins constitute other veins found to date.

(a) No. 3 Vein occupies the same regional shear zone as the No. 1 vein. A test shaft was reported sunk to 75 feet in the 1920's and encountered good stibnite mineralization at the shaft bottom. Some stibnite and oxide is present in the dump.

Trench 31 revealed that the stibnite mineralization is confined to fractured quartzite adjacent to the footwall. The hanging wall is in quartz-sericite schist. The quartzite is in the form of a small symmetrical anticline (see Drawings 13 & 14). The shear zone (vein?) is 19 feet wide, strikes 87° azimuth and dips 55°-60° south. The shear zone itself is not mineralized. The quartzite beds are intersected by the shear at a favourable angle on the top 8 feet of the anticline and this is where the mineralization is localized. Below this, the quartzite bedding parallels the shear footwall thus no stibnite mineralization is localized. In view of this structural control, stibnite is dissipated into tension fractures and bedding planes of the anticline instead of being concentrated into a well defined vein. One channel sample taken at the footwall quartzite wallrock returned 6.5% Sb across a true width of 2 feet on the south limb of the anticline, another channel sample taken on the north limb and consisting of dissipated stibnite and oxides returned 3.75% Sb across 10.5 feet. The average for the mineralized zone, based on 5 channel samples, is 5.2% Sb across 5.2 feet of average true width.

Trench 33 is 250 feet west and 33 feet lower than Trench 31. It exposed a thick quartzite bed on the hanging wall side of the shear. The angle of intersection between the quartzite and the shear zone is not amenable to rupture, thus no stibnite mineralization is localized. No important minerlaization was encountered 200 feet east of Trench 31 in Trench 32, since the shear zone is in quartz-sericite schist. The quartzite in Trench 31 plunges 5°-10° east, therefore Trench 32 was too shallow to locate it. A co-incident arsenic-antimony geochemical soil anomaly lies over the Trench 34 area. Additional trenching on the uphill side of this anomaly, i.e. 200 feet east of Trench 34 will likely encounter the mineralized zone which, is at the same elevation as the bottom of the prospect shaft.

(b) <u>No. 4 Vein</u> was discovered by Trench 41. It is 650 feet N75^{o}E of the No. 2 vein. It strikes N45^{o}E and dips 55^o SE. The vein cuts through the axis of an anticline in quartzitic schist. It has well defined walls and is 5 feet wide on the east wall of the trench, on the west wall however, it broadens into a 25 foot wide sheeted zone, consisting of parallel and cross cutting faults. A 2 foot wide parallel vein lies 10 feet southeast of it. Low angle faults offset the veins for 3 to 4 feet. Vein matter consists of maroon coloured clay gouge and breccia, impregnated by streaks, pods, lenses, stringers and disseminated stibnite and its oxides. Mineralization is very similar to the No. 2 vein.

One channel sample was cut from the east wall and fourteen were taken from the west wall. These fifteen samples combined, returned 1.68% Sb across an average width of 3.1 feet. From work completed to date, indications are that the No. 4 vein is a separate vein by itself. It is probably sub-parallel to or arranged en-echelon with the No. 2 vein. Both the strike and depth extension of the No. 4 vein remains to be tested.

(c) <u>No. 5 and No. 6</u> (See Dwg. 10, Trench 24)
Both veins were uncovered in Trench 24. No. 5 strikes 45^o and No. 6, 55^o az., both dip 50-60^o south. The exposed section of No. 6 vein is 4 feet to 6 feet wide and No. 5 vein is three feet to five feet wide. The wall rock is quartzitic schist containing occassional pure quartzite interbeds up to two feet thick. Both veins have gravity or normal fault movements. The net slip based on quartzite marker beds is approximately ten feet. Numerous low angle faults and quartz boudin occur near the vein. No. 5 vein is offset six feet northeasterly by a cylindrical fault. No. 6 vein is offset five feet southwesterly by a low angle thrust fault.

Vein matter is similar to that in the No. 2 and No. 4 veins. Stibnite accompanied by its oxides occurs as stringers and streaks up to a foot wide separated by a few inches of gouge intermixed with small pods and disseminations. Larger patches occur where quartzite beds are intersected by the vein at an angle causing maximum rupture, e.g. No 5 vein on the west wall of the trench.

Three channel samples taken from the No. 6 vein returned a combined average of 6.54% Sb across a true width of 4.53 feet. Two channel samples taken from the No. 5 vein returned a combined average assay of 5.30% Sb across 3.25 feet of true width.

Both veins remain untested in strike and depth extensions. Current work suggests these are different veins from the No. 2 or No. 4 veins. They are arranged either parallel, subparallel, or en-enchelon with the No. 2 and 4 veins. Until proven by more work, the possibility that both veins represent the faulted extensions of No. 2 and 4 veins, should not be discounted because Trench 24 and 41 are the only two areas encountered where cross-cutting faults displaced the veins. Another possibility is that these two veins may be branches of the No. 2 and 4 veins or are parts of a cymoid loop pattern.

Individually, No. 2,4,5 and 6 veins are all weaker in grades and widths than the No. 1 vein. Collectively, these four veins probably present as attractive a target as the No. 1 vein since they appear to be quite close to each other. Evidence to date suggest these 4 veins form a parallel vein pattern possibly arranged en-echelon or otherwise within a horizontal spread of approximately 200 feet. Table 2 summarizes the main features of the vein system.

TABLE 2

SUMMARY OF VEIN SYSTEM

VEIN	AVG. GRADE Sb %	AVG. TRUE WIDTH FT.	TONS PER VRT. FT. @ 11 cu ft/t	STRIKE LENGTH MINERALIZED FT.	PROBABLE VEIN LNGTH FT.	POSSIBLE VEIN LNGTH FT.	DEPTH ASSURED FT.	PROBABLE DEPTH FT.	POSSIBLE DEPTH FT.
No. 1	13.5	9.3	215	220	580	850	80	200	450*
No. 2	5.5	4.7	82	167	1000	1500	110	200	500
No. 3	5.2	5.2	-	20	200**	500**	75	100**	250**
No. 4	1.68	3.1	-	20	1000***	1500	100***	200***	500***
No. 5	5.3	3.3	-	20	1000***	1500	100***	200***	500***
No. 6	6.54	4.5	-	20	1000***	1500	100***	200***	500***

NOTE:

* Assume a 400' thick quartzite bed in Vein No. 1 and both walls mineralized and the faulted extension of quartzite located in the hanging wall.

** Assume quartzite bed encountered to depth of 75 feet re prospect shaft.

*** Veins 4, 5, 6 are similar geologically to Vein No. 2 and thus would have the same characertistics.

Veins No. 2, 4, 5 and 6 occur as parallel vein pattern within horizontal spread of 200 feet.

ORIGIN OF ANTIMONY MINERALIZATION

- Antimony deposits on the property are epigenetic and are formed by hydrothermal processes. They are genetically related to granite stocks of Mesozoic age. Stibnite-gold-quartz lodes in the Cleary Mineralized Zone all occur near intrusives and are believed to have formed after consolidation of the Mesozoic intrusive.

The Scrafford antimony deposits are classed as mesothermal, intermediate temperature, deposits. Stibnite is hypogene. Supergene process contributes to formation of the oxidation products. The stibnite mineralization assays trace amounts of gold and silver (0.02 oz Au, 0.1 oz Ag/ton average). Such auriferous and argentiferous antimony veins are classed as mesothermal deposits by C.Y. Wang. In auriferous stibnite-quartz veins, the stibnite mineralization extends to greater depths than those carrying pure stibnite alone.

The hydrothermal alteration minerals sericite, silica, kaolin, and carbonate are also indicators of a mesothermal deposit. The vertical distributions of different vein exposures of up to 700 feet and showing no change in mineralogical characteristics lends further support to a deeper type mesothermal deposit rather than a shallow epithermal deposit.

Modes of stibnite deposition indicate both fissure filling and shear zone replacement took place. Two stages of mineralization are recognized. The first, started with deposition of white quartz from hydrothermal solution into faults and joints of the country rock. Subsequent movements of the shear and development of dilatant zones was followed by an ingress of mineralizing solution into the dilatant zones which deposited vitreous quartz and stibnite to form the veins.

COMPARISON WITH THE CHINESE ANTIMONY DEPOSITS

A remarkable similarity exists between these deposits and the Hsikwanshan type antimony deposits. The Hsikwanshan mines at one time were the largest antimony producers in China and the world.

Both deposits are localized in veins cutting quartzite near the crest of an anticline. The antimony mineralogy, gangue, structural controls, lithology, and grade are similar. The main characteristics between the two are summarized in Table 3.

TABLE 3

COMPARISON BETWEEN THE SCRAFFORD AND THE HSISKWANSHAN (CHINA) TYPE ANTIMONY DEPOSITS

LOCATION	COUNTRY ROCKS AND SIZE OF ANTIMONY BELT	STRUCTURE	FORM AND DISTRIBUTION	MINERALOGY	AVERAGE GRADE	REMARKS
Hsikwanshan Mines, Hunan Prov., China	U. DEVONIAN Shetieng Chao Series { shale, quartzite, limestone (Rocks in stratigraphic sequence) INTRUSIVE Granite 17 miles E & SW. — — — — — Hsikwanshan antimony field, area 3½ x 2 miles.	- NE-SW folds cut by N-S faults - Anticline quartzite bed 500 ft. thick overlain by impervious shale.	-occur in fractures near crest of anti-cline and adjoining faults, in quartzite. -fissure filling, veins, pods and along joints and bedding planes. -ore bodies irregular, intermittently local-ized in a zone of 1 mile.	Ore: stibnite cervantite stibiconite Gangue quartz barite kaolin sericite gypsum	6% Sb	- Largest antimony producing area of China at one time. - Ore reserve est. 1.5 million tons contained Sb metal. (1973, Can. Min. Jou) - Production estimated at 100,000 tons ore per year. Hand-cobbed to 50-60% Sb ore. - Worked to depth of 300 feet.
Scrafford Property Fairbanks District, Alaska	PRECAMBRIAN Birch Creek Formation { qtz.-ser.-schist, micaceous quartzite, quartzite, talc-graphite-ser.- schist (Rocks in mixed interbeds) INTRUSIVE Small Mesozoic granitic stocks. — — — — — Cleary Mineralized zone, (antimony field) 2 x 20 miles.	- E-W folds cut by E-W & NE shear zones. - No. 1 vein; anticline quartzite bed 150 feet thickness exposed. Full thickness estimated 400 feet. - No. 2 vein quartzitic schist est. 500 feet thick.	-localized in shear zones at or near crests of anticline in quartzite or quartzitic schist. -fissure filling, veins, pods, lenses, dissem. & streaks within dilatant zones in vein shears. -No. 1 vein in one portion of regional shear zone. No. 2,4-6 veins in consistently mineralized shear zones.	Antimony stibnite cervantite stibiconite kermesite Gangue quartz kaolin sericite calcite hematite limonite graphite	11.3% Sb (No. 1 & 2 veins combined) — — — No. 1 vein, 13.5% Sb No. 2 vein, 5.5% Sb	- Periodic production, limited high grading during high Sb price - No proven reserve to date although reasonable to expect ½M tons potential. - Exploration work to date; 297 tons per vertical foot across 8 feet, for No. 1 and No. 2 veins combined.

WALL ROCK HYDROTHERMAL ALTERATION

Wall rock hydrothermal alteration is most prevalent on the footwall side of the veins, the hanging wall side is unaltered except in rare, isolated cases e.g. Trench 33. The No. 1 and No. 3 vein alteration differs in detail from those at the No. 2 and No. 4 vein area. The No. 1 and 3 veins are marked by two distinctive alteration zones on the footwall side. The inner zone extends out to distances measured in inches to a few feet; beyond it is the outer alteration halo measured in tens of feet. In the No. 1 vein, a 6 inch to 5 foot wide inner zone of intensely hydrothermal altered wall rock extends from the footwall. The width of the zone is directly proportional to the degree of stibnite concentration. It is thus a useful indicator of the location and intensity of stibnite mineralization.

Kaolinization (argillic alteration) and silicification combined are the dominant alteration processes involved. This highly altered zone consists of bleached, white to flesh coloured flake like or dense aggregates of kaolin sericite and carbonates. Accompanying the kaolinization is strong silicification which introduced silica. Where recrystallization happens, clear fine grain quartz is formed. Yellowish and maroon limonite and hematite stain or smear and lesser amounts of manganese oxide is superimposed on the above. The intense alteration softened this zone and near surface it is an incoherent mass of finely ground, light coloured and pulverulent clay like material, (See Plate B-3).

Beyond this zone a weaker alteration halo extends further for tens of feet. The halo is characterised by pervasive maroon, purplish or cocoa coloured hematization of the wall rocks. Yellowish brown limonite is intermixed with it. Subordinate black manganese oxide often coats fracture planes. Moderate to weak kaolinization, silicification and sericitization are locally discernable.

The stripped area of the No. 2 vein does not display these two distinctive zones. The vein footwall is bordered by a subparallel fault. This 2 to 10 foot wide bounded area is dominated by yellowish limonitic stain and silicification accompanied by weak kaolinization. A pervasive cocoa or maroon coloured hematitic alteration halo similar to that in the No. 1 vein extends for tens of feet beyond the No. 2,4,5 & 6 vein footwalls. It is often possible to locate mineralized parts of veins by tracing this supergene hydrothermal alteration halo. This has been successfully demonstrated by trenching, particularly in the No. 2 and 4 veins area, using the halo as an indicator to find the location and intensity of stibnite mineralization.

CONTROLS ON STIBNITE DEPOSITION

Stibnite veins are localized in sections of strong shear zones. The veins are formed wherever shear zones intersect competent quartzite and quartzitic schists at favourable angles.

The change in the nature of vein faults as they pass from one rock type to another is dependent on the contrast in mode of failure between competent and incompetent materials. Field observations indicate the degree of competency and the tendency to form veins decreases according to the rock types in the following order: thick-bedded quartzite, thin-bedded quartzite, quartzitic schist, quartz-sericite schists and other pliable schists. Stibnite deposits found to date are all confined to the first three rock types. As the shear zones pass through different rock types, dilatant zones are liable to form in the competent quartzite and quartzitic schists and constrictions in the incompetent, pliable quartz-sericite schist and other schists.

The formation of favourable loci for stibnite deposition is a function of:

(a) relative rock competency
(b) angle of intersection between shear and bedding and
(c) direction of movement of the shear walls.

The direction of shear movement, and the angle of intersection between the shear and the bedding attitude of competent rock determines the degree of rupturing to provide such favourable loci. This angle of intersection is measured from a plane formed by the shear wall, in the direction of its movement, with the dip of the bedding, i.e., rupture favors competent rock whose bedding dip is away from the direction of shear movement and vice versa. Maximum rupturing would occur for angles up to 90° and decreasing from 90° to 135°. Beyond 135°, i.e. where the bed dips towards or into the direction of the shear movement, little or no rupturing takes place. Of course, when bedding is parallel to the shear wall, at 180°, no rupture can occur at all.

Rupture takes place up to an angle of intersection of 135° because the shear wall movement is toward the direction of greatest resistance in the competent rock. Consequently, a competent rock would fail by rupture through a continued increase in the stress and dilatant zone results. A dilitant zone is accentuated in competent rocks when the shear zone direction is deflected, e.g. the middle of No. 2 vein. Unfavourable angles of intersection, 135°-180°, result in no dilitant zone being created since the shear movement complies with the plane of least resistance of the competent wall rock. Incompetent and pliable schists due to their plasticity, fail by flexure, drag and flap; thus they do not form dilatant zones. Figure 4 illustrate, in a diagrammatic manner, the principles involved.

Dilatant zones cause a marked increase in volume. Ingress of mineralizing solutions would seek the dilatant zones, which are sites of low pressures and low chemical potentials, for stibnite deposition. The overlying and adjoining impermeable quartz-sericate schist and gouge act as a capping or barrier to the mineralizing solution. This confines and limits the location of mineralized zones. A combination of these processes control both the horizontal and vertical size, distribution and shape of the stibnite veins.

All veins known to date display this principal on controls of stibnite deposition:-

- In the exposed section of the No. 1 vein, the 60° south dipping, gravity movement, shear zone cuts the crest of an anticline. A thick quartzite bed, constituting the north limb of the anticline, lies on the footwall side. The shear or vein footwall moves upward and is opposed to the yield direction of the quartzite bed. This angle of intersection creates open spaces and forms dilatant zone loci for stibnite deposition. The impermeable clay gouge and the incompetent, pliable and impervious hanging wall quartz-sericite schist act as barriers or seals limiting the stibnite vein to the footwall side half of the shear zone. In contrast, a 20 foot thick quartz-sericite schist interbed, near Trench 5, is not amenable to form dilatant zones, as such, this area constitutes the weakest and narrowest portion of the vein.

- In the No. 2 and 4 vein areas, the vein shears cut through competent quartzitic schists at favourable angles on both walls and form dilatant zones. As a result, stibnite mineralizations occupy all sections of the shear zones in No. 2, 4, 5 and 6 veins. No 5 vein (see Drawing 10, west wall of Trench 24) illustrates how rupture in a quartzite interbed developed a dilatant zone to accomodate a large stibnite replacement pod and increased the vein width.

FIGURE 4.

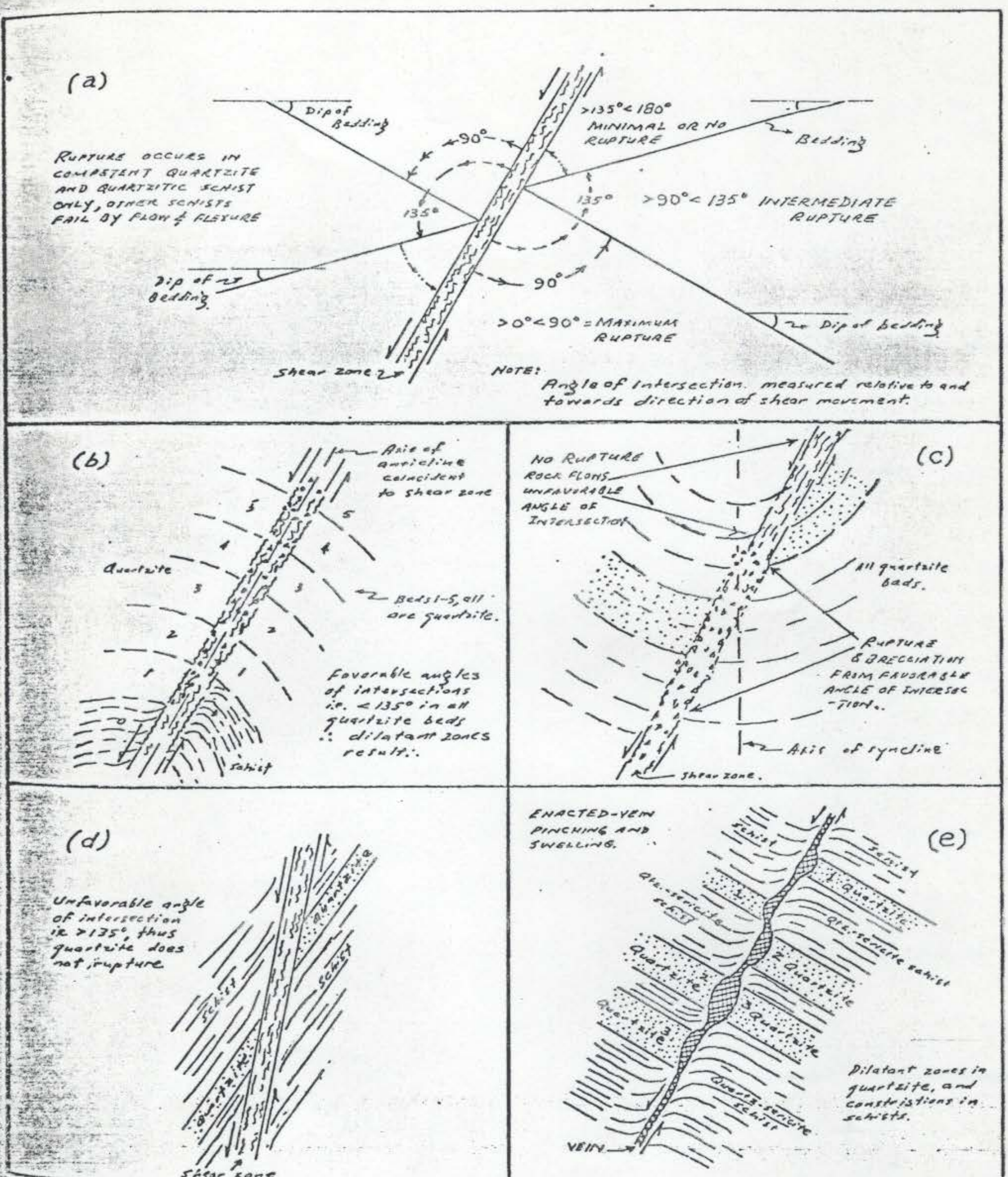


FIG.4 - Structural and lithological controls on stibnite deposition. Sketches show angle of intersection between bedding and shear movement to form dilatant zones.
(a) procedure used to measure angle of intersection,
(b) dilatant zone via favourable angle of intersection,
(c) change from unfavourable to favourable angle,
(d) unfavourable angle, (e) vein pinching and swelling controled by relative rock competency in favourable angle of intersection.
Same principals apply to plan view for transcurrent fault.

- No. 3 vein, see Drawing 13, is a typical case where, due to changes in the angle of intersections, the quartzite anticline on the footwall side is partly favourable to stibnite deposition and partly not. Under such conditions most of the stibnite is dissipated into adjacent tension joints and fractures in the quartzite, rather than being concentrated into a dilatant zone to form a defined vein.Drawing 16, demonstrates where an unfavourable angle of intersection negates formation of dilatant zones in the competent quartzite on the hanging wall.

SAMPLING, GRADE CALCULATIONS AND RESERVE ESTIMATE

Channel samples were cut from all veins exposed in trenches, stripping, and the underground workings. The assays were weighted against the sample widths and areas. Samples were sent to Crest Laboratory of Vancouver for assays; a few check samples were assayed by two other umpire assayers viz: - Loring Laboratory of Edmonton and TSL Laboratory of Vancouver.

SAMPLING AND ASSAYING

The sampling was done by L.J. Manning, P.Eng., assisted by the writer. Some samples were taken by the writer only. Standard size channels were cut on all vein materials sampled. The soft vein gouge facilitated in cutting sample channels and usually only a pick was required, assisted at times by a hammer and moil for harder vein material. Often, several individual channel samples were cut along the same sample line, when the materials differed in physical characteristics. Each sample assay was weighted against its width and later combined to arrive at a representative channel sample assay for the true width of that section of the vein. Sometimes samples were cut at different angles rather than across true width, because of problems encountered in the manner of vein exposures.

Each of the five underground samples from the No. 1 Vein assayed a consistant 0.02 oz/ton gold, 0.1 oz/ton silver and averaged 18.05% Sb over a true width of 15 feet. One sample, #T4, from the No. 2 Vein assayed 0.24 oz/ton gold and 35.85% Sb across a true width of one foot. The No. 2 Vein is thus higher in gold content. Unfortunately, not all the channel samples were assayed for gold and silver to determine an average value of the two metals in the veins.

Concentrates from the preliminary metallurgical flotation tests assayed as follows:-

Vein	Sb%	As%	Pb%	Ag oz/ton	Au oz/ton	Feed
No. 1:	63.89	0.21	trace	0.45	0.09	(9.54%Sb)
No. 2:	52.16	0.57	trace	0.60	0.64	(8.74%Sb)

The No. 1 Vein composite feed sample is mainly a stibnite ore, whereas the No. 2 Vein sample contains a high proportion of antimony oxides.

Two representive samples of direct shipping ore, taken from the stockpile being loaded at the Fairbanks railway yard for shipment to Japan, averaged as follows:-

Sample No.	Sb%	As%	Pb%	S%	Acid Inso. %
17026-17027:	28.87	0.71	trace	5.72	59.46

GRADE CALCULATION AND RESERVE ESTIMATE

Grade calculation is based on assay results of channel samples taken from all vein exposures. The average grade is arrived at by weighting the appropriate assays against the sample widths and the areas of influence. The reserve estimate is determined, where feasible, by using a tonnage factor of 11 cubic feet per ton.

No. 1 Vein:

The average grade of the No. 1 Vein is 13.5% Sb over an averaged true width of 9.3 feet in an exposed strike length of 220 feet. This segment of the vein contains 215 tons per vertical foot, on surface. The No. 1 Vein calculation was done by L.J. Manning, P.Eng. The assays and sample locations are shown in Drawings 22 and 22A. Reserve calculation is shown in Drawing 23 and is based on sub-dividing the vein into six blocks.

A total of 64 channel samples were taken from the surface exposure of the No. 1 Vein, partly to investigate if the possibility of a low grade open pitable deposit exists. Finally 14 of these samples from the mineralized vein portions were used to calculate the average grade. Seven underground channel samples were excluded from the average grade calculation. The underground samples averaged 18.05% Sb, 0.02 Au/ton and 0.1 Ag/ton over an average true width of 15 feet. W

No. 2 Vein:

The 167 feet of continuously exposed strike length of the No. 2 Vein averaged 5.5% Sb across an average true width of 4.65 feet and contains 82 tons per vertical foot, on surface, in this segment of the vein. Its strike extension, exposed 180 feet to the southwest by Trench 23, was not included in the grade calculation. This extension returned an average of 2.77% Sb over a true width of 4.3 feet. The grade calculation was done by the writer and duplicated by L.J. Manning. Assays and sample locations are shown in Drawing 18 and the calculation in Table 4.

A total of 35 channel samples were taken from the 167 feet of exposed strike length, 29 of these were used in the grade calculation. One sample, 474, was assayed for gold content. It returned 0.24 oz Au/ton and 38.85% Sb over one foot, indicating the No. 2 Vein has a higher gold content than the No. 1 Vein.

Other Veins:

The other veins were all exposed by one trench each, therefore no estimate of tons per foot can be made. No. 4, 5 and 6 veins are similar in nearly all aspects to the No. 2 vein. It is inferred they would have the same magnitude of antimony mineralization when explored further. Results to date on the No. 3 vein are not too conclusive. The averages of channel samples taken from these veins are as follows:-

Vein	True Width	Sb%	No. of Samples
No. 3	5.2 feet	5.2	5
No. 4	3.1 feet	1.68	15
No. 5	3.25 feet	5.30	2
No. 6	4.53 feet	6.54	3

The ores and concentrates from these veins are of premium quality because of the absence of deleterious smelter impurities and the carriage of appreciable amounts of by-product gold and silver.

Reserve Estimate:

In determining the reserve estimate a tonnage factor of 11 cubic feet per ton was used. Work to date has exposed and developed mineralized segments containing a "proven tonnage per vertical foot of 297 tons, at the surface, grading 11.3% Sb across an average true width of 8 feet" for the No. 1 and No. 2 veins combined. At $1 a pound antimony, this grade has a gross value of $226 per ton, in situ. Results to date indicate the property contains a surface exposure of 953 probable tons per vertical foot. Table 5 - page 41, summarizes the reserve calculations.

The No. 2 Vein, at 1800 feet elevation, is 700 feet vertically above the No. 1 Vein (at 1100 ft. elevation). Both veins occur in strong shear zones and are identical in mineralogical and host rock characteristics. These observations confirm that the veins should have excellent depth potentials. When the surface exposure of 953 probable tons per foot is considered at half square, i.e. to a depth of 567 feet, it calculates to 540,000 tons of "possible" ore inferred by surface work completed to date. Should this ore be identical to that previously developed (i.e. 11.3% Sb across 8 feet true width), then every justification exists for a 500 t.p.d. milling and mining operation. The four other discovered veins plus several potential mineralized zones revealed in the geochemical survey, when developed further, could contribute to additional ore reserves in the future.

The preceding discussions verify that excellent situations are present in proving up ample ore reserves to sustain a future 500 t.p.d. or larger mining and milling operation.

TABLE 4: CANTU NO. 2 VEIN RESERVE CALCULATIONS

(See Dwg. No. 18)

W L	Area	% Sb	% Sb X Area
5.0 X 6.50	32.50	3.79	123.18
4.5 X 8.50	38.25	1.46	55.84
6.2 X 8.50	52.70	3.41	179.71
5.5 X 6.00	33.00	1.09	35.97
5.0 X 6.50	32.50	4.01	130.32
4.5 X 9.50	42.75	5.20	222.30
6.0 X 9.75	58.50	1.15	67.28
5.6 X 14.25	79.80	8.46	675.11
5.4 X 15.50	83.70	8.04	672.95
9.5 X 8.50	80.75	3.06	247.10
9.0 X 10.00	90.00	12.81	1,152.90
6.0 X 12.00	72.00	2.46	177.12
4.0 X 10.00	40.00	2.92	116.80
4.5 X 10.00	45.00	3.38	152.10
3.5 X 15.00	52.50	5.28	277.20
3.7 X 12.25	45.33	11.30	512.23
4.5 X 4.50	20.25	4.98	100.84
92.4 167.25	899.53	5.45	4,898.95

Average True Width - 5.38 X sin 60^{o} = 4.65 Ft.

Average Grade = 5.45 %Sb.

Tons per vertical foot = 82 tons @ 11 cu ft/ton

GEOCHEMICAL SOIL SURVEY

The property area is overlain by residual sub-arctic brown forest soil. The vegetation cover is typical sub-arctic boreal forest of the type found close to the tree line. It includes moss, birch, aspen and black spruce. Extensive permafrost exists in the valley and lower slopes with seasonal frost lasting until late July or August.

Orientation Survey:

In late July, 1970, when the ground had thawed sufficiently, an orientation geochemical soil survey was conducted. Soil samples were collected from each soil horizon of the soil profiles exposed in trench walls. Soil samples were collected from both mineralized vein areas and from unmineralized shear zone areas. The results proved that a geochemical soil survey is useful in locating underlying mineralization. The top of the "B" soil horizon was chosen as the most practical sample layer. Antimony, arsenic and copper contents were analyzed. Arsenic proved to be an excellent pathfinder element for antimony mineralization. Copper distribution is inconclusive.

Immediately following this, a geochemical soil sampling programme over the entire property was initiated. The field work was conducted by Tricon Exploration Services of North Vancouver, under the writer's supervision. Unfortunately, the survey began after most of the trenching was completed. Areas near and downhill from trenches were not soil sampled because of anticipated contamination by the trench debris.

Field Procedure and Analytical Method:

Using the Murphy Dome Road as a baseline, flagged grid lines at 400 foot spacing wererun north-south across the entire property. The grid totals 38 line miles. One soil sample was taken at each 200 foot station along the grid lines. A total of 1511 soil samples were collected.

A mattock was used to obtain the soil sample at the top of the "B" soil horizon just below the bottom of the "A" horizon. Wherever possible, every sample was collected from the identical "B" soil horizon so as to prevent contamination and variation in metallic contents

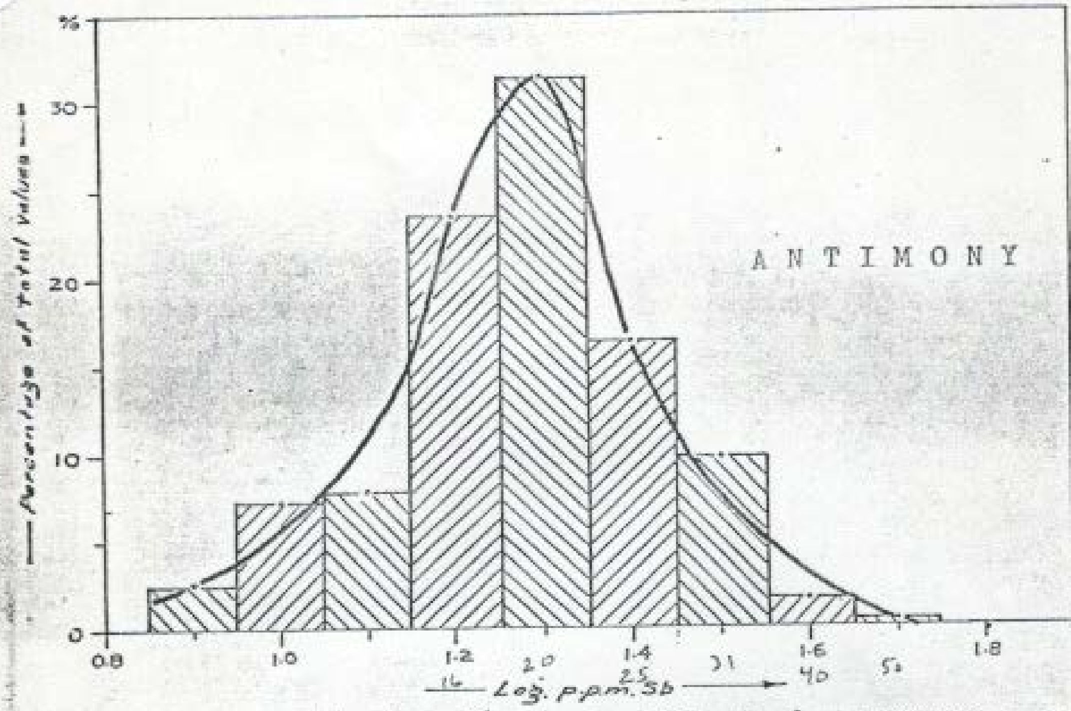


FIG. 5 - Frequency distribution and histogram of Antimony in 1511 soil samples from both background and anomalous areas - Scrafford Antimony Property, Eagle Creek area, Fairbanks District, Alaska.

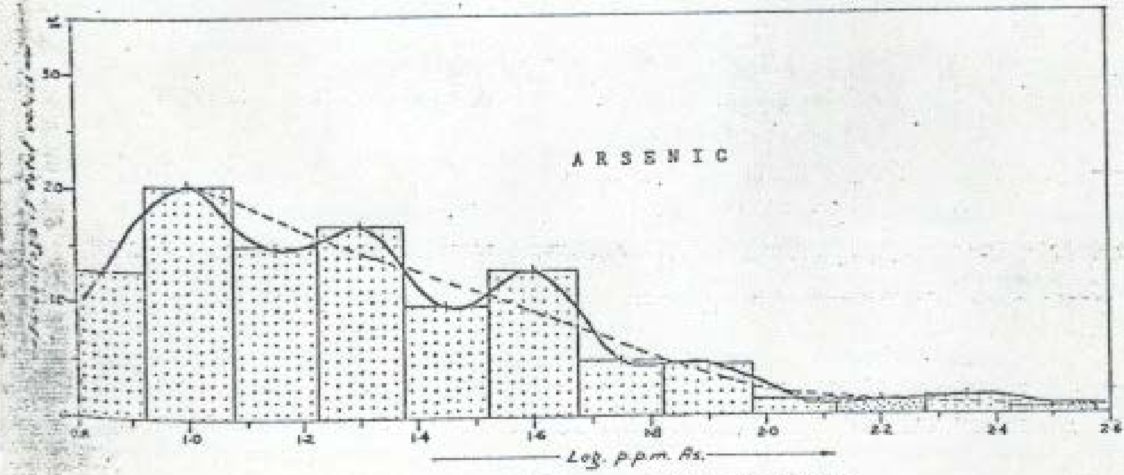


FIG. 6 - Frequency distribution and histogram of Arsenic in 1511 samples of soils from both background and anomalous areas.

from other soil horizons. About a handful of the soil sample was collected in a waterproof kraft paper bag. Field notes on the terrain, soil characteristics and drainage were recorded for each sample location. Sample depths were variable but averaged less than 2 feet from surface.

The soil samples were sent to Chemex Laboratory in North Vancouver for analyses. Chemex reported:- "the samples were dried and sieved to -80 mesh, 0.5 grams of each sample fraction was digested in hot 70% perchloric and concentrated nitric acid. Both antimony and arsenic contents were determined for each sample by the atomic absorption method."

Data Treatment:

A total of 1511 soil samples were analysed for both antimony and arsenic contents. The results are treated statistically. Fig. 5 and 6 are the frequency distribution curves and histograms for antimony and arsenic respectively. Antimony distribution shows a symmetrical curve, arsenic distribution is erratic but averaged as an asymmetrical curve skewed to the right. These curves are included for those readers who prefer such presentation of data.

The writer follows the procedure developed by C. Le Peltier in the graphical representation of geochemical data. Soil antimony contents range from 5 to 50 ppm and arsenic from 5 to 350 ppm. A log interval of 0.1 is used for antimony and 0.15 for arsenic. Table 6 - antimony and Table 7 - arsenic, shows the computations and resulting tabulations.

These data are plotted on probability-logarithm graph paper to construct the cumulative frequency curve. The ordinate is plotted at class limits, thus cumulative frequency is plotted against the class limits. Fig. 7 shows the results of this plotting.

The straight line obtained for both antimony and arsenic indicates the values are log. normally distributed for both sets of data. The negatively broken antimony line indicates an excess of low values in an essentially log. normal distribution.

Mean background is given by the intersection of the line with the 50% ordinate and is the geometric mean of the

TABLE 6-ANTIMONY FREQUENCY DISTRIBUTION

Class int. Log.	Class int. ppm Sb	Frequency	% of Total Value	Cumulative % Frequency
0.9	8	39	2.6	100.0
1.0	10	107	7.1	97.4
1.1	13	119	7.9	90.3
1.2	16	355	23.4	82.4
1.3	20	474	31.4	59.0
1.4	25	245	16.2	27.6
1.5	32	146	9.7	11.4
1.6	40	23	1.5	1.7
1.7	50	3	0.2	0.2
	Total	1511	100.0	

Population:-N = 1511 Range:- R = 5 to 50 ppm

Log. interval = $\frac{\log.R}{n^*} = \frac{\log.\ (50/5)}{10} = 0.10$

*n = number of points on curve

TABLE 7-ARSENIC FREQUENCY DISTRIBUTION

Class int. Log.	Class int. ppm As	Frequency	% of Total Value	Cumulative % Frequency
0.85	7	196	12.97	100.00
1.00	10	305	20.19	87.03
1.15	14	225	14.89	66.84
1.30	20	250	16.51	51.95
1.45	28	145	9.66	35.44
1.60	40	191	12.62	25.78
1.75	56	70	4.63	13.16
1.90	80	65	4.30	8.53
2.05	110	20	1.32	4.23
2.20	160	18	1.19	2.91
2.35	220	22	1.46	1.72
2.50	320	4	0.26	0.26
	Total	1511	100.0	

Population :-N = 1511 Range:-R = 5 to 350 ppm

Log interval = $\frac{\log R}{n^*} = \frac{\log 350/5}{12} = 0.15$

*n = number of points on curve

FIGURE 7.

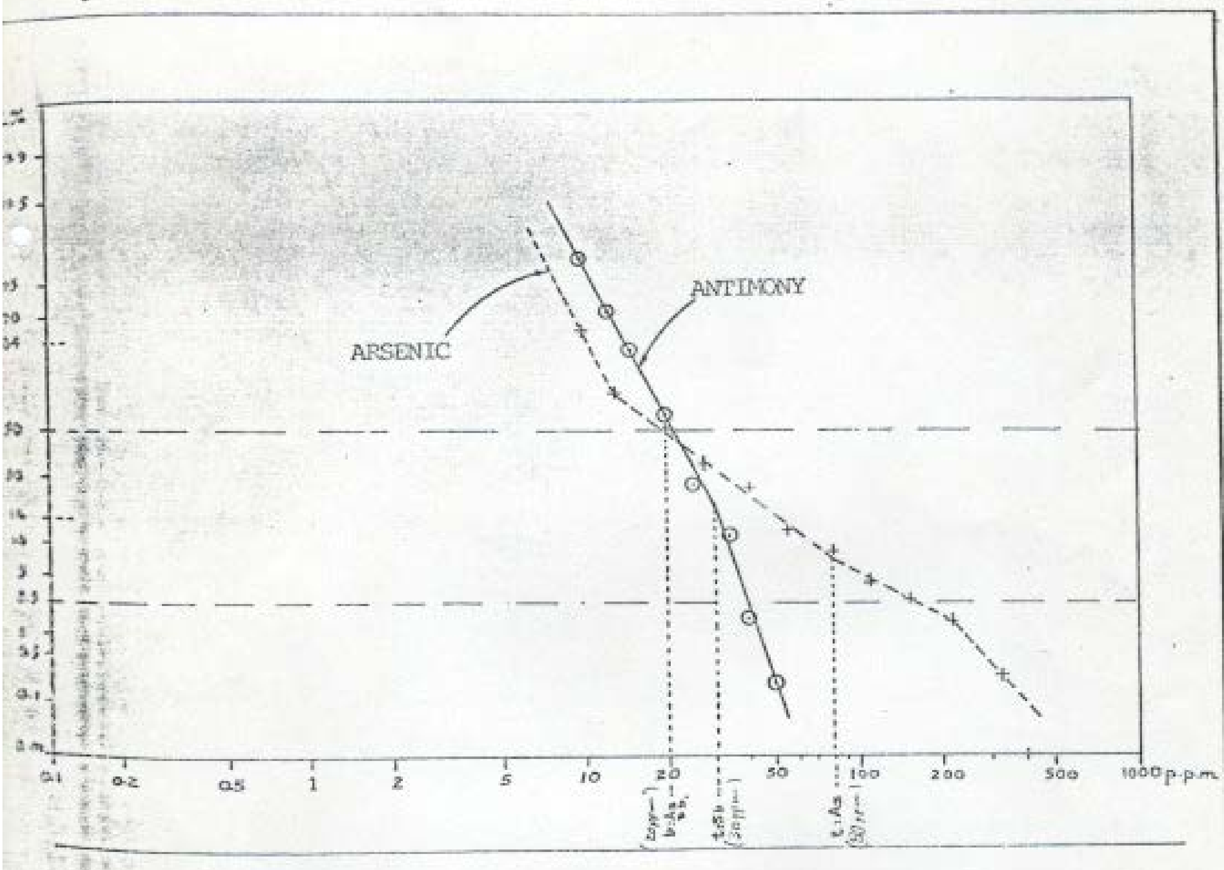


FIG. 7 - Cumulative frequency plot for Antimony and Arsenic

Population = 1511

b = Background

t = Threshold

As = Arsenic, Sb = Antimony

result. Threshold is taken at the inflexion point occurring above the 2.5% line. The threshold value is 1.5 times mean background for antimony and 4 times mean background for arsenic. Values higher than the threshold are considered anomalous.

Contour intervals in Drawings 26 - Antimony and 27 - Arsenic, are selected on the basis of class limits and interpretation of the cumulative frequency curves.

	Antimony-ppm	Arsenic-ppm
Normal background fluctuation	5-30	5-80
Mean (geometric) background	20	20
THRESHOLD	30	80
Possible anomaly	30-40	80-160
Probable anomaly	40-80	160-320

Discussion of Results:

Drawing 26 is the antimony geochemical soil plan. Drawing 27 is the soil arsenic plan reproduced in sepia for use as an overlay to facilitate interpretation. Coincident or correlative antimony and arsenic anomalies combined are of prime importance. Arsenic in the orientation survey was found to be an excellent pathfinder element for antimony. Both metals have low mobility, but the range of arsenic contents in soil is much greater than antimony, thus arsenic provides a wider contrast.

Anomalies discussed in order of importance are as follows:-

(1) Two separate arsenic anomalies along the same N60^{o}E strike, are partly coincident and correlative to three antimony anomalies. They occur north of the Murphy Dome road in Section 15. The southwestern arsenic anomaly is 1400 feet being separated by 900 feet of background soil from the other 1900 foot long anomaly to the northeast. The three antimony anomalies are from 600 feet to 800 feet in length and are separated from each other by 600 feet of background soil. They are distributed along the same N60^{o}E strike but slightly further downslope from the arsenic anomalies. These anomalies combined with the background soil sections have a total correlated length of 4200 feet. They reflect that strong underlying antimony mineralizations could exist. Two smaller coincident

east-west antimony-arsenic anomalies to the east of Independence Creek, in the same Section, may represent the strike extensions of No. 3 vein.

(2) At the northwest corner of the survey area in Section 17, a 3000 foot long east-west arsenic anomaly with a north-easterly branch is coincident to an area of antimony values just 2 ppm short of being anomalous. This area reflects a probable underlying east-west vein and the junction of a northeasterly vein. Another smaller co-incident anomaly trending east-west occurs 2000 feet south of it.

(3) The east-west linear antimony anomaly in Section 22 is correlative to a small arsenic anomaly. This could represent a yet undiscovered east-west vein.

(4) The two antimony anomalies at the boundary of Sections 20 and 21 are not associated with arsenic anomalies. The anomaly at the headwaters of O'Connor Creek is likely the strike extension of No. 2 vein, since its projected strike extension to here would intersect the crest of a regional anticline mapped by the U.S.G.S.

(5) The coincident east-west arsenic-antimony anomaly in Sect. 16 extending from Trench 34-36 is probably derived from the No. 3 vein where it is inferred to emerge near surface 200 feet east of Trench 34.

(6) Several small isolated antimony anomalies in Section 22 are not correlative to arsenic anomalies. Some of these are related to northeasterly vein systems and others to east-west vein systems.

All these anomalous areas should be geochemically surveyed in detail on 100 foot line spacing at 50 foot sample stations. The detail survey area should be within a distance of at least 200 feet beyond the anomaly boundaries. This programme is considered to have been successful in locating other potential vein areas on the property. Some of these geochemical anomalies, (1)to (3), indicate that the potential underlying mineralizations are of equal or greater magnitude than those found to date in the No. 2 and No. 4 veins. When the proposed detail geochemical soil survey is completed, the best targets so confirmed, should be trenched by bulldozing and those of lesser importance tested by shallow pitting.

METALLURGY

Most antimony ores can be successfully concentrated by combined gravity separation, flotation and tabling. Where cheap labour is available, e.g. China, Bolivia, Mexico and South Africa, antimony ore is hand sorted for direct shipment. At other antimony mines, the sulphide ore (stibnite), containing from 1.5% to 10% Sb, is concentrated by a combination of flotation and tabling, whereby a concentrate grading 55-65% Sb is obtained at 85%-95% recovery. Sunshine Mining Co., Idaho, recovered antimony by electrolysis from solutions, obtained by using hot sodium sulphide to dissolve the antimony contained in the tetrahedrite concentrate. Antimony oxides have not been successfully floated. Hand sorting and hand jigging have been used to concentrate oxide ores for shipment.

Testing Methods and Results:

On July 31, 1970, Pamicon Development Ltd., North Vancouver, instigated a preliminary metallurgical test on the beneficiation possibilities of the Scrafford antimony bearing material. H.M. Thurgood, P.Eng., directed and supervised the test programme. Reports on the test results are included in Appendix IV. The following is a quote from Mr. Thurgood's summary report:-

> "...to date the following tests have been completed with indicated results as noted:
>
> (a) Complete flotation tests were run on three ores utilizing variations of reagents, conditioning times, and other variables.
>
> - All tests were good on the flotation of sulfides.
> - All test were fair to poor on the bulk flotation of combined oxides and sulfides.
> - All tests were fair to poor on the flotation of oxides.
>
> The flotation testing was suspended pending assay results for As and S to confirm material balances and total antimony recoveries.

(b) Scrubbing tests were completed on all ores.
- these tests indicated a high percentage of colloidal material and a tendency for the stibnite to slime and the sulfur, arsenic, and antimony to be slightly concentrated in the slime fractions."

Assessments of the Pamicon flotation test results (Appendix IV, page IV-16), indicated a 92% recovery was achieved for the stibnite but only a 52% recovery for the oxide-sulphide ore mixture. However, mining beyond 70 feet from the surface would obviate the oxide recovery problem, since oxidation only extends to this depth. Concentrates from this flotation test assayed as follows:-

VEIN	Sb %	As %	Pb %	Ag oz/ton	Au oz/ton	FEED
No. 1:	63.89	0.21	trace	0.45	0.09	(9.54%Sb)
No. 2:	52.16	0.57	trace	0.60	0.64	(8.74%Sb)

The No.1 Vein result is from the weighted average of two feed samples consisting mainly of stibnite ore whereas the No. 2 Vein feed contains a high percentage of antimony oxide ore. A prime concentrate is thus obtained because of the absence of deleterious smelter impurities and the carriage of appreciable amounts of by-product gold and silver.

Cantu Minerals leased the Busty Bell gravity mill (50TPD capacity) at Fox in August, 1970, to concentrate some of the low grade stockpile ore. A mill sampling test programme was conducted and supervised by H.M.Thurgood,P.Eng. Results of the test are included in Appendix IV. The following summarizes Mr. Thurgood's Memorandum of October 6, 1970:-

	Sb %	As %	S %
Feed	3.77	0.60	0.26
Table	39.88	0.80	5.73
Jig	55.21	0.32	14.69
Tail	2.40	0.58	0.02

Average concentrate grade 42.94%Sb
Recovery 38%
Concentration ratio............. 29.6:1
Feed rate per day measured ..... 26.5 tons

These results showed that most of the arsenic was carried away in the tailings. Flotation test was completed on tailings of the mill sampling, but this programme was temporarily suspended pending receipt of further assays and technical data. Visual indications are that a good concentrate can be obtained.

Britton Research Laboratories, Vancouver, conducted two separate metallurgical tests on samples of the stockpile ore from the No. 1 vein. The tests consisted of flotation and tabling. Their test on a 100 pound composite sample of partially oxidized material achieved a 58.6% recovery, in which 82% of the stibnite was recovered. The head sample assayed 21.75% Sb, the combined concentrate graded 61.0% Sb, 0.63% As and 0.05% Pb. Britton's opinion is that at least 85% of the stibnite would be recoverable with further cleaning (See Appendix 1V). These tests were done in 1965 for Silver Ridge Mining Ltd.

Discussions:

Results from these metallurgical tests indicate successful and satisfactory recovery of sulphide antimony (stibnite) but most of the oxides are not recovered. Inference from field observations to date is that oxidation is not expected to extend deeper than 60-75 feet below surface. Beyond this depth, antimony mineralization would be essentially in the form of stibnite. Should mining operations exceed this depth, the oxide recovery problem could be obviated.

Regarding the treatment of oxidized antimony ore, C.Y. Wang, reported that:-

(i) F.W. Belash obtained a 75% recovery from an ore containing stibnite and its oxidation products by flotation and tabling its tail, in the Kamandzhai (U.S.S.R.) antimony plant. Optimum results were obtained thus:- ore crushed to -80 mesh, reagent consumption viz. $CuSO_4$ 400 gm/ton; shale tar 500 gm/ton, and fine oil 180 gm/ton.

(ii) Adelaide School of Mines, Australia, researched on developing a process for treatment of oxidized antimony ore. It was found that at pH7 cervantite floated after sulphidizing with sodium sulphide.

Should antimony oxides become a major recovery problem with the Scrafford mineralization then further tests, based on ore-dressing methods mentioned above, should be attempted.

From results of metallurgical testing completed to date, it is inferred that the milling and recovery of the Scrafford antimony mineralization will be best accomplished by combined gravity separation, tabling and flotation.

ECONOMIC CONSIDERATIONS

A preliminary theoretical case study, to examine some of the variables involved in the economic aspects of mining was undertaken by L.J. Manning, P.Eng. Trenching cost calculations were done by H.M. Thurgood, P.Eng., since this was, and will be, a major exploration expenditure. Some of the marketing parameters associated with antimony ore are discussed.

Theoretical Case Study:

Both the No. 1 and No. 2 veins were used as models in this theoretical study and their merits compared. Drawing 24 is the plan and projection of the No. 1 vein and Drawing 25 of No. 2 vein. These show how the veins will occur if no further, as yet undisclosed, controls exist to further delimit their antimony mineralizations. It should be emphasized that the full thickness of the quartzite bed host rock has not yet been exposed on surface. The following is an excerpt from Mr. L. J. Manning's report dated August 5, 1970; his Drawings 17 and 18 are the same as Drawing 24 and 25 respectively in this report.

> "The accompanying tables on Dwg. No. 17 (24) and 18 (25) indicate the source from which $5M operating profit may be derived. $5M was chosen as an adequate ore-equivalent to repay the nominal capital required by a small mill with allowance for preliminary mine development and an operating profit. The depth required to provide this return from an exposure like No. 1 vein with operating costs of $25 and $50 while obtaining various market prices is indicated on Drawing No. 17 (24). Drawing No. 18 (25) indicates the required exposure for a similar return from an occurrence like the No. 2 vein.
>
> If Drawing No. 17 (24) (Vein 1 type) is considered, with operating costs of $50 and market price of 65¢ per pound of Sb, it is evident that $5M operating profit would require the milling of 55,000 tons. If this were milled out in three years, a mill of 50 tons per day capacity would be required. As the estimated operating profit from type 2 is only $7.50 on an estimated $50 operating cost, and as capital costs for a 600-ton plant would be about $2.0M and underground preparation costs approximately $2.0M for a total capital of about $4M, such a vein would only be developed and mined as an addition to an operation based on vein type 1."

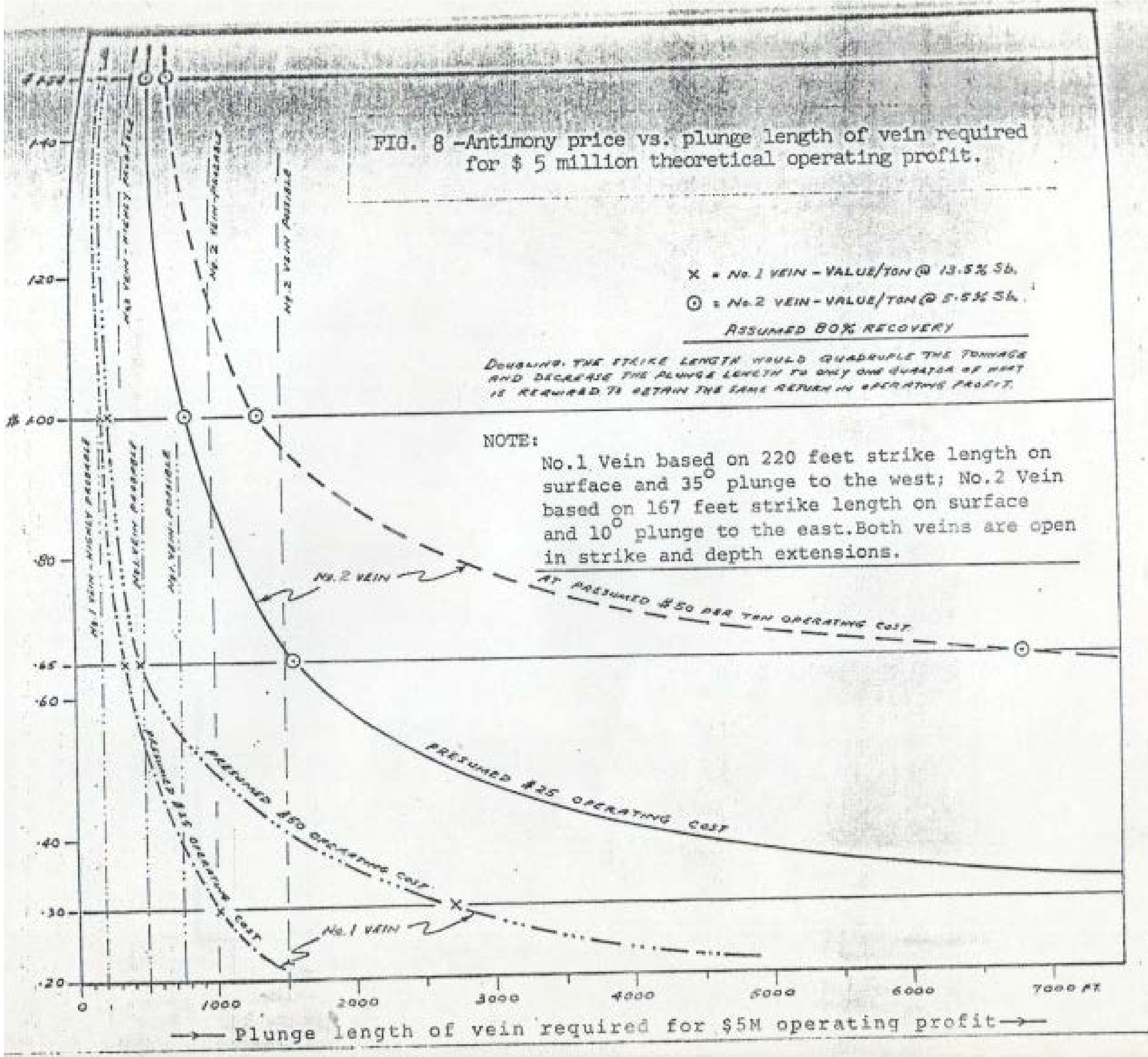


FIG. 8 -Antimony price vs. plunge length of vein required for $ 5 million theoretical operating profit.

FIGURE 8.

Drawings 24 and 25 are self explantory and should be referred to in reading the above excerpts. The plunge length required will be considerably reduced when the full thickness of the quartzite beds are exposed and the attendant increased vein strike lengths are known. For example, doubling the strike length of the No. 1 vein would quadruple the tonnage and reduce the plunge length to only one quarter of what is required for the same return in operating profit. Fig. 8 is a graphical representation, prepared by the writer, based on the calculations contained in Drawings 24 and 25.

Trenching Cost Study:

Trenching and stripping was performed by a DH8 Bulldozer with attached rippers. In some instances an Air Trac was required to drill the frozen ground for blasting prior to bulldozing. A Cat. 966 front-end-loader was used to assist the bulldozer in excavating some trenches. Detail calculations on the trenching cost were compiled by H. M. Thurgood, P. Eng. and are included in Appendix 111. Table 8 is extracted from data contained in this Appendix.

TABLE 8

Trenching Cost Summary - Scrafford Property

Ground Condition	Cu. Yds. Excavated	Total Cost	Cost per Cu. Yd.	Cost Ratio	Trench #
Thawed	24,160	$18,962	$0.78	1:1	23-24 and 31-36
Semi-Thawed	3,120	4,438	1.42	1.8:1	6 and 7
Frozen	9,490	38,861	4.09	5.2:1	2-5,41, Vein 2 Stripping.
TOTAL	36,770	$62,261	$1.69	2.2:1	15 Trenches Vein 2 Stripping.

It is apparent from the preceding Table that the cost is lowest in thawed ground, where only ripping followed by bulldozing is needed. Unless absolutely necessary, trenching should be avoided in frozen ground since the cost is increased by a factor of 5.2 times. This cost increase is attributed to costs burden borne by required drilling and blasting of the frozen ground prior to trenching.

Marketing:

Historically, the market price of antimony has been characterized by abrupt fluctuations due to:

1) "Wide differences between war and peace time demand
2) availability of mainland Chinese antimony
3) the high cost incentive to meet war time demands." - (quoted J. Paone.)

China has traditionally been the largest supplier of antimony to the world market. Prices in 1968 dollars, have seen a low of 4 cents a pound in 1922, to a high of 63 cents in 1951. A shortage of antimony supply in 1969, skyrocketed the price to a historical high of U.S.$4 a pound by March, 1970. This shortage can be explained by:-

i) Disruptions of Chinese production due to the Red Guard Cultural Revolution between August, 1966, and late 1968-69.

ii) The Bolivian miners' strike in 1967-68 which interupted productions.

iii) Increased demand from the escalation of the Vietnam war and continued uncertainty in the Middle East conflict between Isreal and Egypt.

iv) Increased demands for consumer goods, especially automobiles, in the sudden unprecedented booming economy of other neighbouring S.E. Asian countries as an outcome of the Vietnam war.

The New York antimony price rose sharply from a low of 44 cents per pound in March, 1969, to a record $4 per pound a year later. Metals Week Quotation for the ore (+60% Sb) was a record $43-$45 per short ton unit in June, 1970. Since then, the price had been declining and by September, 1970, the metal was quoted at 85 cents to $1.05 a pound and the ore at $25-$27 per s.t.u. By 1971, the metal price had somewhat stabilized. The Metals Week average quotation (N.Y.) for June, 1973, was 65 to 70 cents per pound for antimony metal and $9.20 to $10.20 per s.t.u. for the ore.

An unprecedented demand for antimony usage in flame retardants could be generated from the passing of U.S. government legislations, sometime this year, requiring the flame proofing of children's night wear and the interiors of automobiles and other passenger carriers. Recent utilization of high purity antimony in the manufacture of semi-conductors and thermo-electric devices augments new consumption patterns. These new uses are certain to raise and stabilize the future antimony price and prevent its historically wide price fluctuations. The supply-demand relationship for antimony-1968, is illustrated in Figure 10, page 57. Consumption growth rate for the metal is projected at 3% to 4% per year in its traditional uses. The total world consumption of antimony metal in 1968 was 90,000 tons, about 50% of which was consumed in the United States. The United States is dependant on foreign sources for its antimony ore and metal. Its smelters import 93% of their ore requirements from foreign sources, mainly Mexico, Bolivia and South Africa.

The marketing of antimony concentrate, should the property prove to be an economically viable mining proposition, is best accomplished by:-

a) Long term sales contract with a smelter based on a floor price with bonus percentage provisions when the antimony market price escalates.

b) Arrangement with a large antimony consumer to participate in the mining project.

c) Open market sales through concentrate purchase agents or short term contract sales with several smelters.

Methods a) and/or b) are most desirable if a mining operation is carried out on a larger scale, say 200-500 tons per day. This will ensure a secure market to justify the capital expenditure required in such an undertaking. Method c) is less attractive and in only

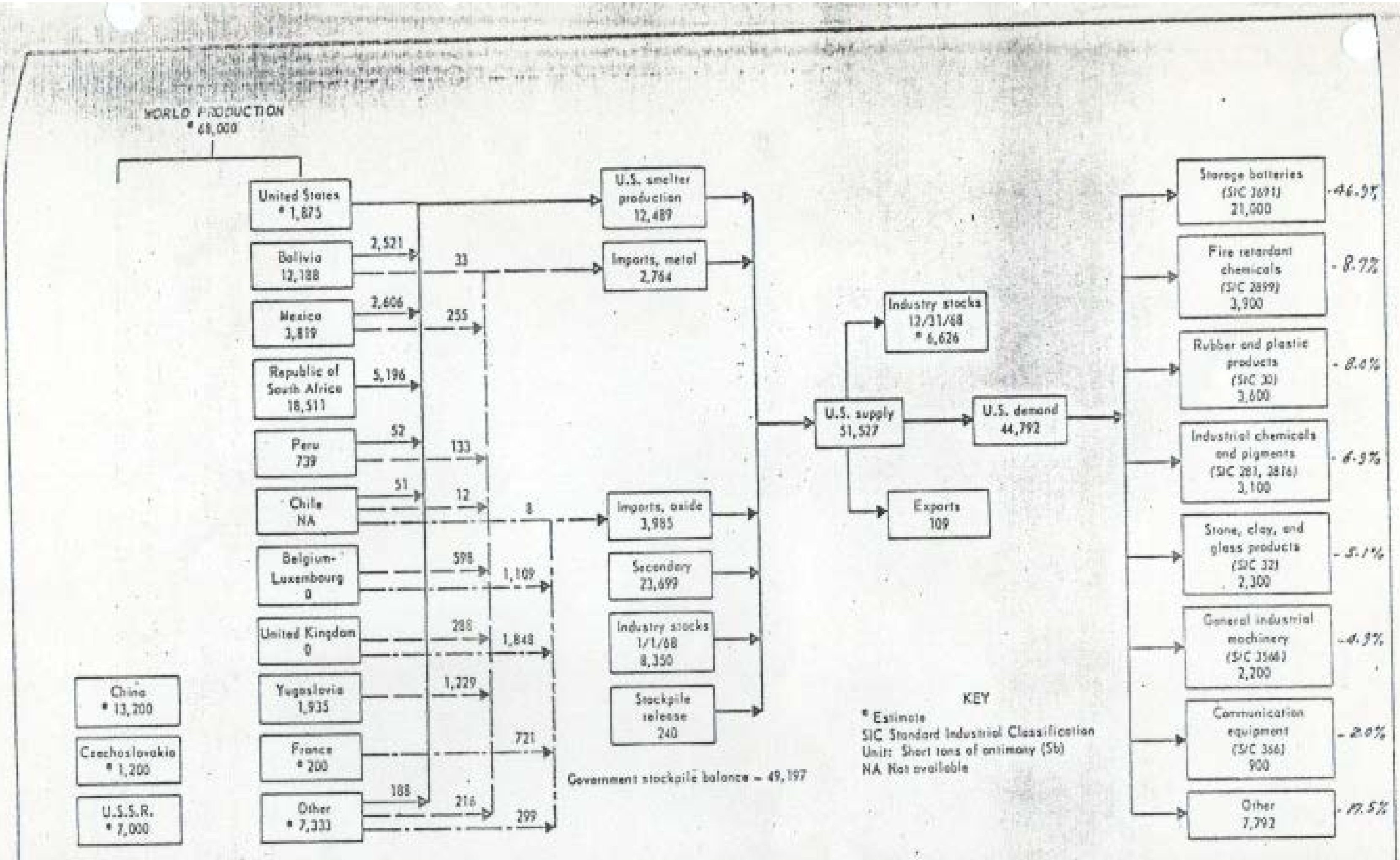


FIG. 9 – Supply-Demand Relationships for Antimony, 1968 (U.S.A.).

(after J. Paone.)

practical on a small scale, high grading, operation at times of high antimony price.

Japanese smelters seem the most logical ore purchasers to approach because of their faster consumption growth rate for antimony and the shorter shipping distance from Alaskan ports. Currently, steel pipes and ancillary equipment for the construction of the Trans Alaskan Pipeline are being shipped from Japan to the Fairbanks depot. An advantaged freight rate based on a "back-haul" to Japan with the same shipping lines could be negotiated. United States smelters are next, followed by the European smelters.

CONCLUSIONS AND RECOMMENDATIONS

1. Exploration and development to date has exposed and indicated a "PROVEN TONNAGE PER VERTICAL FOOT OF 297 TONS, at surface, grading 11.3% over a true width of 8 feet" for the No. 1 and No. 2 veins combined. Both veins are open in strike and depth extensions. The No. 1 Vein averaged 13.5% Sb across 9.3 feet and the No. 2 Vein 5.5% over 4.7 feet. The No. 2 Vein is 700 feet vertically above the No. 1 Vein, therefore the veins should have excellent depth potentials.

2. Results to date indicate the property contains a surface exposure of 953 tons per vertical foot. When this is considered at half square - to a depth of 567 feet, it calculates to 540,000 tons of "possible" ore inferred by surface work to date. Should this ore be identical to that developed previously (i.e. 11.3% over 8 feet true width), then every justification exists for a 500 t.p.d. milling and mining operation.

3. The four other veins, discovered by trenching, plus several other potential mineralized zones revealed in the geochemical survey could contribute to additional ore reserves in the future.

4. The veins are localized along segments of strong shear zones and are composed of stibnite, antimony oxides and by-product gold and silver in a clay gouge and quartz gangue. Oxidation is inferred to extend no deeper than 70 feet from the surface. These deposits are remarkably similar in geological settings to the Hsikwanshan antimony mines, which at one time were the largest antimony producers in China and the world.

5. The ores and concentrates from this property are of premium quality because of the absence of deleterious smelter impurities and the carriage of appreciable amounts of by-product gold and silver.

6. Wall rock alterations consist of a narrow zone of kaolin-quartz-carbonate-limonite and an outer cocoa coloured hematite halo, that extends for tens of feet beyond the vein footwall. This halo serves as a useful exploration guide to the locations of antimony mineralizations.

7. An unprecedented demand for antimony usage in flame retardants could result from the passing of U.S. government legislations, this year, requiring the flame proofing of children's night wear and the interiors of automobiles and other passenger carriers. This new demand alone is certain to raise and stabilize the future antimony price and prevent its historically wide price fluctuations.

8. The property is accessible year round via 18 miles of well maintained highway from Fairbanks, which is linked by railway to the deep seaports of Anchorage - 340 miles and Seward - 420 miles. Road distance from Fairbanks to the ice-free seaport of Valdez is approximately 320 miles. Most amenities pertaining to a mining operation are available in the Fairbanks area.

9. The property is in permafrost terrain. Active layer glide, via solifluction and gravity, distorts all geological structures within this layer, which extends up to 20 feet below surface. Caution should be excercised in the interpretations of geologic data obtained in the active layer, since they are of non-diastrophic origin.

10. Preliminary metallurgical tests indicate that recovery is best accomplished by combined gravity separation, tabling and flotation. Stibnite recovery is in the +90% range, but most of the oxides are not recoverable. Should future mining operations extend beyond the zone of oxidation, 60-75 feet below surface, then the oxide recovery problem will be obviated. It is possible that gold and silver values contained in the antimony concentrate will be able to defray part of the freight costs.

11. Historically, the price of antimony has been subjected to wide fluctuations. Most of the word's antimony has traditionally been supplied by China. Concentrate sales based on a floor price long-term smelter contract is most desirable or alternatively, arrangements should be made with a major antimony consumer to participate in future mining operations in order to obtain a secure market to justify the capital expenditure required.

Based on the foregoing, a systematic exploration programme is recommended. The purposes are: To test for vein depth and strike continuity of the No. 1 and No. 2 veins, continuity of the favourable quartzite and quartzitic schist at depth, to obtain some drill indicated reserves, explore other veins further and check target areas outlined by the geochemical soil survey.

The programme is to consist of the following:

1. <u>Diamond Drilling - BQ wireline</u>

No. 1 Vein - Recommended drill pattern and targets are:

(i) 3 sets of fan drill holes with 2 holes in each drill site, one hole at -45° and the other at -75°, to intersect the vein at 100 feet and 200 feet respectively below surface. The drill sites are to be spaced 100 feet apart, along the exposed 220 foot section of the vein, on the south side of the vein. This totals 1800 feet of drilling.

(ii) One 300 foot vertical drill hole sited 100 feet east of Trench 3 on the hanging wall side. This hole is drilled to locate the faulted extension of the quartzite bed on the hanging wall side, to intersect the vein at 150 feet below surface and to check the continuity of the quartzite bed on the footwall side. Another 350 foot vertical hole located south of the above is planned to intersect the vein at 250 feet below surface. These two holes and the 3 sets in (i) would test a total strike lenth of 400 feet, i.e. allowing 50 foot drill hole spacing influence from the end holes, and a depth extension test to 250 feet below surface. Data obtained could also be utilized to obtain a drill indicated reserve.

(iii) One 500 foot stratigraphic drill hole on the footwall side of the vein, near Trench 4 to determine the thickness of the quartzite bed. A second 400 foot vertical stratigraphic hole, collared 150 feet east of Trench 5 on the footwall side, should be drilled to verify and confirm the plunge of the quartzite bed and its thickness.

No. 2 Vein

(i) Fan drilling with 2 holes on each of 6 drill sites located south of the vein are planned. The two holes on each site are to be drilled at -60^o and -90^o respectively, in order to intersect the vein at 100 feet and 200 feet below surface. The first 4 sets of holes are to be spaced 100 feet apart in the stripped area of the No. 2 vein. The two sets at the opposite ends are spaced 150 feet from the last drill sites. This drilling would test a total strike length of 750 feet, i.e. allowing 75 feet beyond the end holes due to the influence of drill hole spacings, and test the depth extension to 250 feet, i.e. allow 50 feet hole spacing influence.

(ii) A vertical 400 foot drill hole, collared south of the vein, drilled to test the continuity of the quartzitic beds and to locate the vein at 300 feet below surface.

Data obtained from this drilling could be used to calculate a drill indicated reserve.

Total footage required in the 23 drill holes is 6000 feet; 3500 feet are allocated to the No. 1 vein and 2500 feet to the No. 2 vein.

2. Trenching

(i) One bulldozer trench sited approximately 200 feet southwest of Trench 41 and two other trenches to be located northeast at approximately 100 feet and 200 feet respectively from Trench 41are planned. The trenches should be excavated in such a manner as to locate not only the strike extensions of No. 4 vein but also, if possible, that of No. 5 and 6 veins. This trenching would test an approximate strike length of 400 feet.

(ii) Bulldozer stripping of the area east of Trench 5, No. 1 vein, to expose the top of the quartzite bed.

(iii) One trench to be excavated 200 east of Trench 34 to verify the validity of the coincident arsenic-antimony soil anomaly and to locate the projected extension of No. 3 vein.

(iv) Three trenches are added as ~~a~~ contingency for evaluating the geochemical targets.

The total volume of excavation required is estimated to be 20,000 cubic yards.

3. Detail Geochemical Soil Survey

Conduct a detail soil sampling programme, at 100 foot line spacing and 50 foot sample stations,over the three best target anomalies discussed earlier. This programme entails collection of an estimated 4000 soil samples, which are to be analysed for both arsenic and antimony contents.

4. Geophysical Survey

An electromagnetic survey at 50 foot coil separation utilizing the vertical loop SE300 E.M. system, is to be conducted over targets obtained in the detail geochemical soil survey. This work is estimated to require 15 line miles of surveying.

A magnetometer survey over the entire property at 400 foot line spacing is recommended. This survey would be useful for interpretation of the underlying geology since the property area is characterized by a scaricty of outcrops. It is anticipated that the survey would also be capable of detecting the shear zones.

The magnetometer survey grid is estimated to total 38 line miles. A detail magnetometer survey at 50 foot station readings, over the E.M. grid, is to be carried out concurrently with the E.M. survey. Pervasive hydrothermal alterations, adjacent to veins, are inferred to likely be expressed as magnetic lows or depressions due to the destruction of magnetic and paramagnetic minerals by the hydrothermal alteration process.

A combination of the detail geochemical soil survey, E.M. survey and detail magnetometer survey is anticipated to be able to locate the mineralized veins.

5. Road Building

A total of 2 miles of tote road for access to drill site and trenching is required.

6. Metallurgical Testing

Complete the previous metallurgical test programmes so that the material balance and calculations on recovery can be finalized. Conduct a new test programme consisting of combined gravity separation, tabling and flotation of the table tail to confirm the physical feasibility of concentrating the antimony mineralization.

7. Marketing Study

Conduct a market study and survey on potential antimony concentrate purchasers.

COST ESTIMATES

1.	Diamond drilling, 6000 ft @ $10/foot		$60,000
2.	Trenching and stripping 20,000 cu. yds. @ $1/cu. yd.		20,000
3.	Detail geochemical soil survey 4000 samples @ $4/sample		16,000
4.	Geophysical Survey:-		
	(a) S.E. 300-electromagnetic survey 15 line miles @ $100/mile	1,500	
	(b) Magnetometer survey reconnaissance 38 miles, detail 15 mi. Total 53 mi. @ $50/mi.	2,700	4,200
5.	Road building-2 mi. @ $2500/mi.		5,000
6.	Metallurgical testing		2,500
7.	Marketing Study		1,000
8.	Assaying 100 samples @ $7/sample		700
9.	Data compilation and interpretation		1,500
10.	Resident supervision and engineering		4,000
11.	Misc.: transportation, room & board etc.		1,500
12.	Contingencies		11,600
	TOTAL		$128,000

Depending on the results of the above programme, future work is envisaged to consist of fill-in drilling and underground exploration and development of the No. 1 and No. 2 veins to obtain proven reserves, and detail exploration to determine the merits of new target areas.

Respectfully submitted,

S. S. Tan, B.Sc., P.Eng.

SST:kdl

CERTIFICATE

I, Siak S. Tan, residing at 310 - 1965 West 8th Avenue, in the City of Vancouver, Province of British Columbia, hereby certify that:

1. I am employed as a geologist by L.J. Manning and Associates Ltd., with offices at 310 - 890 West Pender Street, Vancouver, B.C.

2. I am a graduate, B.Sc. (Geology) 1964, of Carleton University, Ottawa, Ontario. I completed one academic year, during 1964-65, of graduate studies in economic geology and petrology towards an M.Sc. degree, at the University of Toronto, and have practiced my profession since that time.

3. I am a registered member, through the Board Examination, in Geological Engineering, of The Association of Professional Engineers of the Province of British Columbia, a Fellow of the Geological Association of Canada and a member of the Canadian Institute of Mining and Metallurgy.

4. I have no interest, direct or indirect, in the properties or securities of Cantu Minerals Association or any of its affiliates, nor do I expect to receive any such interest.

5. The attached report on the Scrafford Antimony property is based on the compilation and interpretation of data from my personal work and observations, gained during my capacity as a resident geologist on the property between May 7 - August 15, 1970, and on the study and research of private reports and other publications.

DATED in Vancouver, British Columbia this 15th day of December , 1973.

Siak S. Tan, B.Sc., F.G.A.C., P.Eng.