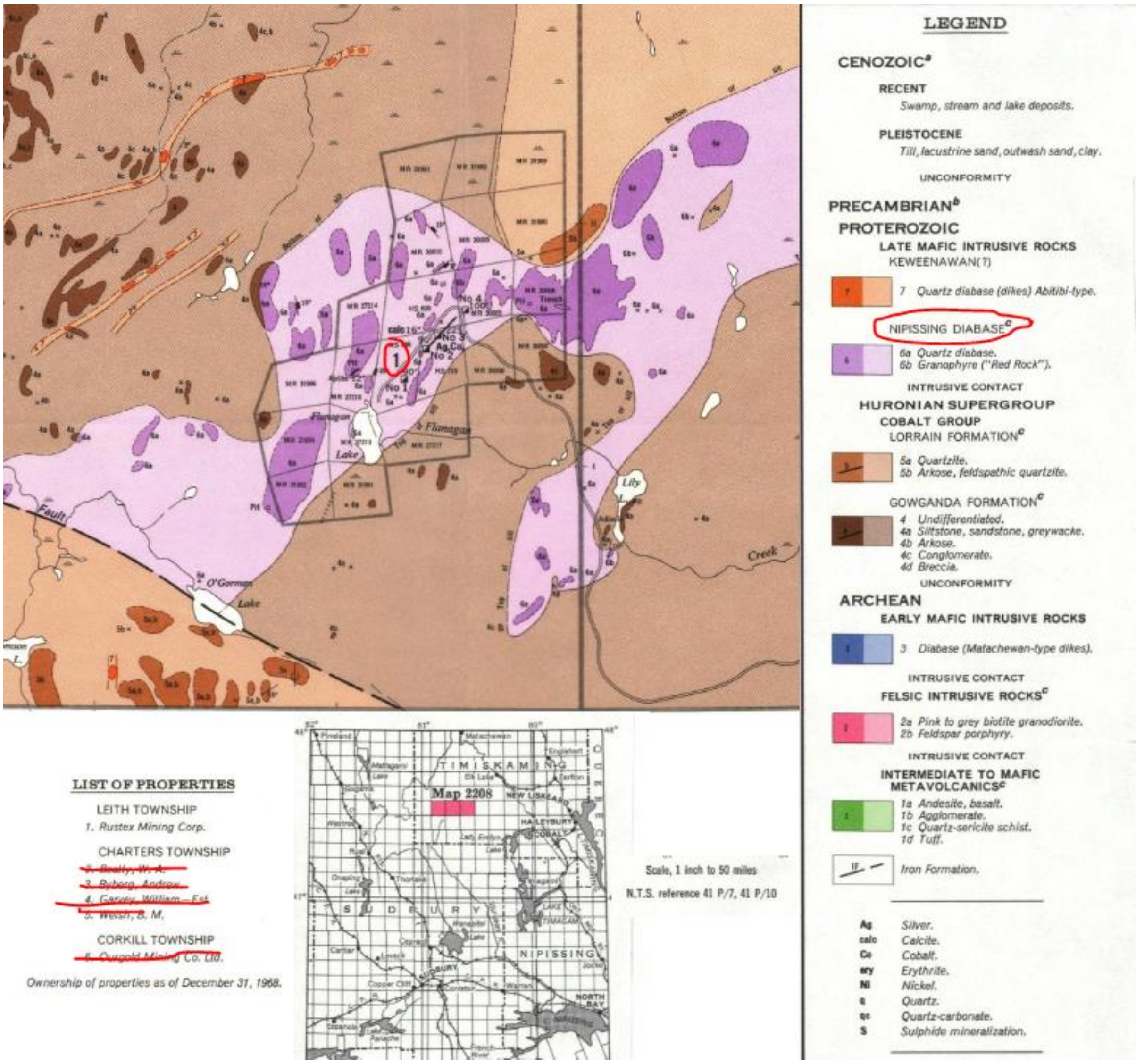
Summary of Ontario Geological Survey Document RE: Rusty Lake Mines

Historically known as; Rustex mine, Hudson Bay Mine

Geology of Leith, Charters and Corkill Townships

Geologically the map-area is in the northwestern corner of a large basin of flat-lying Huronian sedimentary rocks that have been intruded in numerous localities by Nipissing Diabase sheets and later diabase dikes. In many respects it is similar to other areas in the world where basins of flat-lying sedimentary rocks have later been intruded by diabase sheets, such as Tasmania, Antarctica, South Africa, Brazil (Carey 1957), and Guiana (Hawkes 1966). Local topographic highs in the crystalline basement have resulted in Archean inliers within the Huronian sedimentary rocks.



Mineral Exploration

Prospecting in Leith, Charters, and Corkill Townships resulted from the more widespread search for areas of Nipissing Diabase that prospectors hoped would lead to further discoveries of rich silver deposits similar to those found in the Cobalt area. Silver was first discovered in Cobalt in 1903 and following this discoveries were made in the Elk Lake area in 1906 (MacKean 1968, p.l) and in 1907 a discovery was made on Bloom Lake in the Gowganda area (Moore 1955, p.2).

The first discovery of silver in the present map-area was made in 1908 by Dan O'Gorman on what became the Hudson Bay silver mine, owned in 1968 by Rustex Mining Corporation; up to 1966 it had yielded 80,186 ounces of silver and 565 pounds of cobalt. The following year, 1909, working in southwestern Corkill Township, Hugh Kell made a silver discovery in a narrow northwest-trending ridge of diabase. It is known as the Kell Mine and was owned, in 1968, by Ourgold Mining Company Limited; 1,620 ounces of silver have been won from the discovery.

General Geology

The bedrock, all of which is Precambrian, is readily divisible into four major units as follows:

Nipissing-type diabase and later dikes
Flat-lying Huronian sedimentary rocks
Granitic rocks
Metavolcanic rocks with associated iron formation

Following a period of erosion Cobalt Group sedimentary rocks were deposited; only Gowganda and Lorrain Formations are found in the map-area. The area underlain by Huronian rocks is approximately 85 percent of the total area. Nearly all of Leith Township and part of Charters Township is underlain by the Gowganda Formation. Intruding all previously mentioned rocks is the Nipissing Diabase, which is the main interest to prospectors because of the silver deposits that are associated with it. Northeast-trending diabase dikes of presumed Keweenawan age are the youngest rocks in the area.

Rock types

Huronian Cobalt Group

Flat-lying sedimentary rocks of the Huronian Cobalt Group unconformably overlie the Archean basement rocks. Approximately 85 percent of the map-area is underlain by Huronian rocks, which can be roughly divided so as to say that essentially all of the Gowganda Formation, in the map-area, is in Leith Township and nearly all the Lorrain Formation, of the map-area, is in Charters and Corkill Townships. During the period prior to the deposition of the Huronian rocks the Archean landscape was greatly modified by erosion. This resulted in a rugged terrain upon which the Huronian rocks were deposited. This is partly indicated by the numerous inliers of Archean rocks in areas of predominantly Huronian rocks; two of these inliers, which represent topographic highs hi the basement, are exposed in the Leith-Corkill area. A positive magnetic high (Geol. Surv. Canada 1956) in the area of Ridge Lake may represent a third topographic high indicating the sedimentary rocks here are relatively thin.

Gowganda Formation

The Gowganda is the oldest formation of the Cobalt Group; nearly all of the Gowganda Formation, in the map-area, is in Leith Township, with minor areas exposed in Charters Township. Two areas underlying the Nipissing Diabase in central Charters Township have become exposed due to faulting. The most abundant rock type present is a fine-grained greenish grey siltstone to sandstone that is composed of tightly packed rounded to subrounded quartz grains (0.05 to 0.1 mm) in a chlorite matrix that also contains white mica. The rock is massive and the fresh surface ranges from pale brown to very light grey and is locally mottled. A chemical analysis (Table 5) shows the normal high Al_2O_3 content of sedimentary rocks of this type as well as the relatively high SiO_2. There is, however, an abnormally high Na2O content (cf. Pettijohn 1963). Outcrops around Ridge and Lower Ridge Lakes and west of Hangingstone Lake are predominantly conglomerate and arkose.

Table 5 Complete rock and trace element analyses of Huronian sedimentary rocks; analyses by Laboratory and Research Branch of the Ontario Department of Mines.

	1	2	3	4
	%	%	%	%
SiO_2	65.6	68.6	81.6	84.6
Al_2O_3	17.0	19.0	11.4	10.0
Fe_2O_3	1.20	4.00	2.01	0.15
FeO	3.06	0.60	0.27	0.27
MgO	2.93	0.10	0.1	0.10
CaO	0.34	0.10	0.1	0.11
Na_2O	6.47	0.15	0.05	2.04
K_2O	0.28	3.62	2.93	1.71
H_2O+	2.01	2.49	1.02	0.55
H_2O-	0.20	0.22	0.04	0.04
CO_2	0.08	0.10	0.10	0.12
TiO_2	0.75	0.42	0.22	0.08
P_2O_5	0.14	0.03	0.03	0.01
S	0.01	0.01	0.01	0.01
MnO	0.03	0.01	0.01	0.01
Total	100.1	99.5	99.7	99.8
Specific Gravity	2.65	2.73	2.66	2.57
	ppm	ppm	ppm	ppm
Ba	..	150	200	200
Co	20	7	3	3
Cr	100	50	30	30
Cu	10	3	3	3
Ga	20	20	15	10
Li	30	..	..	..
Mn	..	30	10	10
Ni	60	30	20	10
Pb	10	..	10	...
Sc	20	..	20	..
Sr	15	10	15	10
Ti	70	..	..	..
V	20	30	20	10
Y	40	..	..	..
Zn	150	8	4	4
Zr	..	100	100	50

1. Feldspathic silstone, northern Leith Township, Gowganda Formation.
2. Micaceous quartzite, from shore of Stumpy Lake, Lorrain Formation.
3. Micaceous quartzite, near Calcite Creek, Lorrain Formation.
4. Feldspathic quartzite, northeast of Rustex Mine, Lorrain Formation.

Nipissing Diabase

The Nipissing Diabase is the most important rock type in the map-area from an economic standpoint as it is the host rock for all the known silver occurrences. It was soon recognized, after the first discoveries of silver, that there was a close association of diabase with the silver deposits; consequently areas of Nipissing Diabase have generally been subjected to intensive prospecting.

Early writers (Burrows 1926; Campbell 1930; and others) were of the opinion that the diabase in the Timiskaming region was originally one continuous rolling sill stretching across the whole Cobalt-Gowganda area. More recent workers (Moore 1955; Hester 1967) and the present writer do not accept this idea. Instead there were numerous separate intrusions, formed at about the same time and resulting in bodies of differing shapes and sizes. Most of these bodies would appear, however, to be in the form of local basin and dome structures or, as found in part of the present map-area, tabular dike-like bodies. In the present map-area alone there are parts of at least five separate bodies of diabase.

The only location where the actual thickness of the diabase is known is at the Rustex No. 3 shaft where it is 800 feet thick, but it is much less at the No. 1 shaft. No figures are known for the area from the Montreal River to Steele Lake, but from west to east the diabase becomes thinner due to faulting and subsequent erosion.

The diabase is typical of the Timiskaming region and has been well described in the literature (Bowen 1910; Collins 1910; 1913; 1917; Satterly 1928; Moore 1955; Hriskevich 1968; and others). It is a grey to brown weathering massive rock that forms topographic highs in many places in the area; this is especially so in Corkill Township and southwest of Stumpy Lake in Charters Township. The fresh surface of the rock is typically grey to greyish green and the diabasic texture is apparent. This latter feature is best seen in the coarser grained rocks. The diabase varies from fine to coarse grained with the coarser grained material near the top of the sheet. In thin section the rock is seen to be composed of altered plagioclase (labradorite) laths enclosed by pyroxene (augite) and lesser amounts of orthopyroxene. Quartz is present both interstitially and as a constituent of micropegmatite and the abundance of magnetite is variable. Accessory minerals include carbonate, biotite, hornblende, apatite, and epidote; the feldspar laths are generally masked by white mica and the pyroxene grains are in part altered to chlorite.

Granophyre ("red rock") is locally associated with the diabase in numerous areas in the Timiskaming region. Two small areas occur in the present map-area; one is just west of Wapus Creek and north of Dillabough Lake in Leith Township and the other is north and east of the Rustex Mine, in Charters Township, where there are several scattered outcrops with granophyre and red granophyric spots in diabase. Numerous workers (Bowen 1910; Carey 1957; Hriskevich 1968; and others) have shown that granophyre occurs at the top of the diabase. It is associated with argillaceous sedimentary rocks similar to Gowganda Formation sandstones or greywackes. It has been concluded that the granophyre is a late differentiate of the diabase magma that has reacted with and assimilated sediments of a specific type (Bowen 1910; Carey 1957). MacKean (1968), however, thought that the granophyre had intruded the diabase. In the present area granophyric red spots in normal diabase are found to the north and to the southwest of Lily Lake.

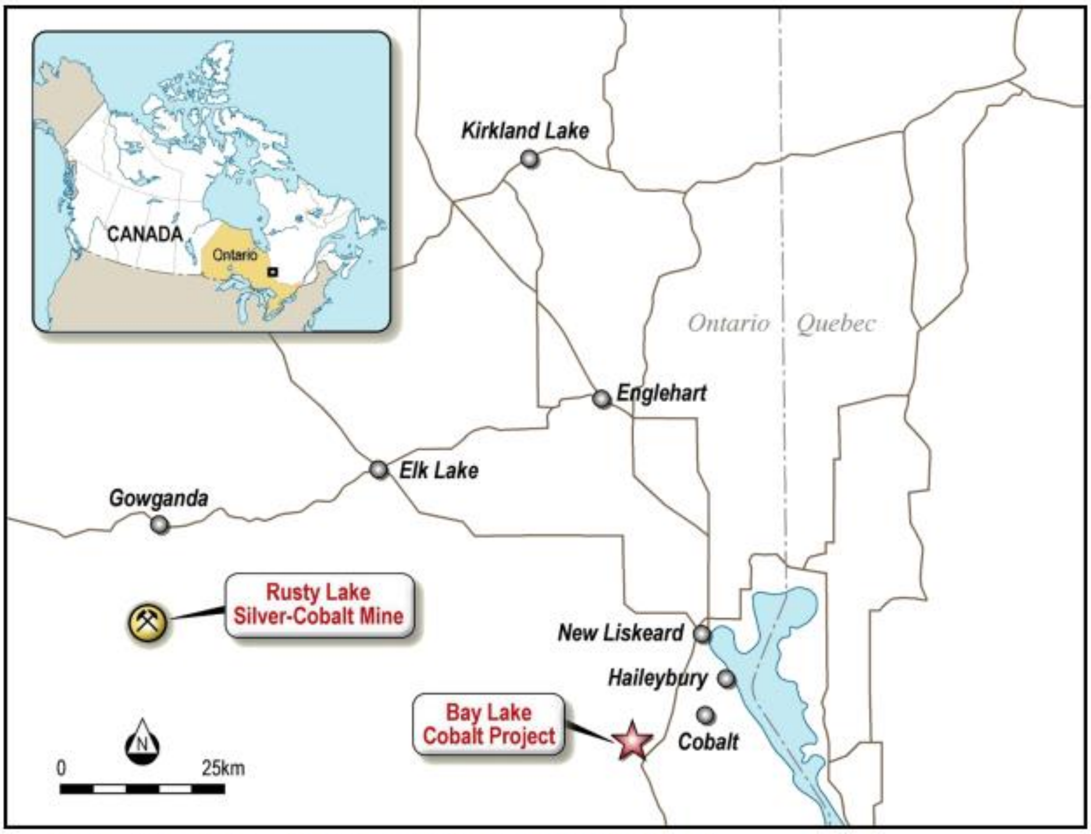
Table 7 | Complete rock and trace element analyses of diabases; analyses by the Laboratory and Research Branch of the Ontario Department of Mines

	1	2	3	4	5
	%	%	%	%	%
SiO_2	48 4	51.6	51.8	59.4	67.2
Al_2O_3	13 3	13.4	14.5	12.2	12.1
Fe_2O_3	16.4	2.87	4.19	5.36	4.28
FeO	1.09	8.85	8.12	6.52	3.80
MgO	6 30	5.35	5.50	2.85	1.00
CaO	6.12	8.61	8.84	3.16	1.84
Na_2O	2 62	2.70	2.82	4.58	5.55
K_2O	0.82	1.52	1.36	0.63	0.24
H_2O+	3.13	2.26	2.05	1.59	0.98
H_2O-	0.36	0 22	0.13	0.17	0.04
CO_2	0.24	0.18	0.11	0.22	1.27
TiO_2	1.31	1.04	0.89	1.14	0.70
P_2O_5	0 15	0.12	0.09	0.18	0.14
S	0.11	0 10	0.11	0.14	0.01
MnO	0.23	0.20	0.23	0.11	0.07
Total	100.6	99.0	100.7	98.3	99.2
Specific Gravity	2.94	2.90	2.96	2.70	2.64
	ppm	ppm	ppm	ppm	ppm
Ag	...	...	...	1	...
As	...	...	...	5	5
Ba	200	...	200	...	...
Co	40	40	40	30	8
Cr	100	150	30	...	...
Cu	110	100	140	80	45
Ga	20	20	20	30	30
Li	50	...	...	...	...
Ni	60	90	80	40	10
Pb	10	15	20	200	10
Sb	12	8	8	12	12
Sc	50	50	50	50	20
Sr	100	200	200	50	30
V	200	300	300	300	...
Y	30	20	20	30	80
Zn	140	120	150	30	60
Zr	150	80	60	200	300

1. Matachewan Diabase from Corkill Township.
2. Fine-grained Nipissing Diabase, Charters Township northeast of Rustex Mine.
3. Fine-grained Nipissing Diabase, Leith Township west of Rustex Mine.
4. Medium- to coarse-grained Nipissing Diabase, Corkill Township south of Michaels Lake.
5. Granophyre, Charters Township north of Lily Lake.

Location and History of the Mine

The original Hudson Bay property was staked in 1908 by Dan O'Gorman and was subsequently acquired and operated by the Hudson Bay Mining Company from 1910 to 1913, when operations ceased. In 1928 Pioneer Prospectors Consolidated Mines Incorporated was formed, which absorbed Silverado and took a favourable option on the Hudson Bay property. Silver Valley Mines Limited was incorporated on June 4, 1933, and acquired part of the Pioneer Prospectors ground and the Hudson Bay group of claims. The property was then worked in1935 and 1936 under the name Silverado Gowganda and from 1937 to 1939 as Silver Valley Mines. The Zagabelt Mining Corporation Limited was formed to continue the option of the Silver Valley Mines Limited from which Leith Mines Limited took over in 1956. In 1960, Rusty Lake Mining Corporation took over the operation to be succeeded by Rustex in 1968.



Map: Location of Rusty Lake Mine and in relation to MTC's Bay Lake High Grade Cobalt Project

Development and Production

Four shafts have been sunk on the property, No. l, No. 2 and No. 3 by Hudson Bay Mining Company and No. 4 by the Silverado Gowganda interests. The principal underground workings are at the No. 3 shaft and are developed at the 76-foot level and the 176-foot level. According to E. L. MacVeigh (1967) 1 , as of June 30, 1966, lateral development on these two levels totalled 3,023 feet, raising 1,162 feet, and a stoping tonnage of 2,749 tons; all present operations are from the No. 3 shaft. Figure 4 outlines the development of the mine to June 30, 1966. Recorded production to 1966 is shown in Table 9.

Table 9 | Production figures for Hudson Bay Mine, owned in 1968 by Rustex Mining Corporation (figures from Ontario Department of Mines statistical files)

YEAR	COBALT pounds	COBALT value	SILVER ounces	SILVER value	TOTAL VALUE
		$		$	$
1936	113	30	...	...	30
1937	...	...	283	127	127
1938	371	167	1,029	442	609
....	...	...	......	......	......
1964	...	...	22,399	31,359	31,359
1965	81	159	28,790	40,306	40,465
1966	...	...	27,685	38,731	38,731
Total	565	356	80,186	110,965	111,321

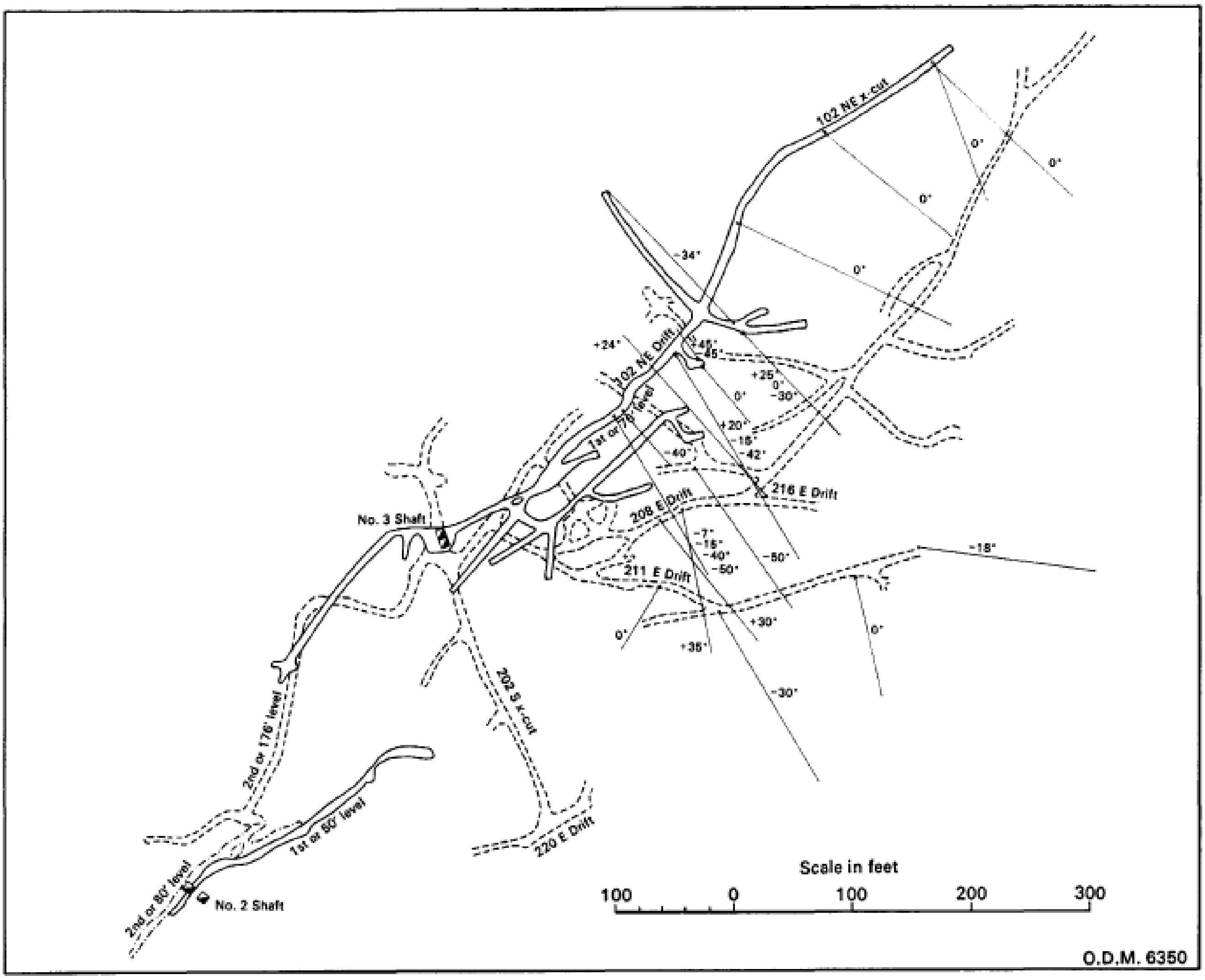


Figure 4–Underground plans at Rustex Mining Corporation property showing pattern of some recent drilling; from company plans dated 1967.

General Geology of Mine

All the rocks in the area of the mine and those encountered underground are Precambrian, the Nipissing Diabase having been intruded between highly folded and metamorphosed Archean mafic and felsic lavas and tuffs and the overlying, relatively undisturbed, unmetamorphosed Cobalt Group of sedimentary rocks comprised mainly of conglomerate and greywacke. The Nipissing Diabase is cut by aplite dikes that strike in northeasterly and northwesterly directions in the vicinity of the No. 3 shaft.

The diabase forms a basin that, in the mine area, appears to dip approximately 10 degrees southeasterly, its thickness being about 800 feet at the No. 3 shaft and much less at the No. l shaft. The question of differentiation of the Cobalt camp diabase magma has been dealt with by Fairbairn et al. (1953), Hore (1910), Satterly (1928), and Hriskevich (1968) among others. At Rustex, information concerning the varieties of diabase is incomplete. However, at the No. 4 shaft the diabase is coarse-grained, usually signifying abundance in quartz and albite and is characteristic of the upper part of the sill, whereas near the No. l shaft the diabase is a uniform, medium-grained quartz variety with grey-green plagioclase, augite, and quartz-feldspar intergrowths indicating a deeper part of the sill (Thompson 1938).

Economic Geology

At Rustex, ore shoots occur in calcite veins found predominantly in the Nipissing Diabase, however, a few silver-bearing veins have been located in the overlying sedimentary rocks. Most of the vein structures are fractures or groups of fractures that strike predominantly northeast, less commonly southeast. According to Russell (1933) the eastern vein of a system north of the Silverado shaft on MR30005 and the vein north of the Lorrain-diabase contact, on GG6549, represent fault fillings. (Claim GG6549 is approximately covered by claim MR31990; for a more exact location see location of claim HS698 on Burrows' (1921) map.) Associated with the calcite veins at Rustex are aplite veins. In any one drift the aplite can occur on both sides or just one side of the calcite vein and irregardless of the number of calcite veins present over the width of the drift only one calcite vein will have aplite associated with it. Where crosscutting relationships are present the calcite vein cuts across the aplite vein. In addition the aplite may contain disseminated metallic minerals, however no report has stated the presence of silver. There has been no work done concerning the variation of mineralogy with depth or along the length of the vein, or the correlation of vein content, aplite, or metallic minerals with vein sets

Mineralogy

The mineral assemblage at Rustex is typical of the Gowganda area and is composed principally of native silver, intimately associated with argentite, smaltite, niccolite, galena, chalcopyrite, and cobaltite (Todd 1926). The principal gangue is calcite with minor quartz present. There are no reports of native silver occurring alone in the veins, however, the cobalt and nickel arsenides often occur without silver.

Occurrence of Mineralization

The metallic minerals occur in bifurcating and trifurcating, predominantly calcite, veins that vary in width from 1/4 inch to 16 inches. Over a stope width of 4 feet there may be four different sets of veins with the ore shoots being erratically distributed in these veins. There are no data as to whether in one drift more than one vein can carry mineralization simultaneously, or whether the ore shoots occur in different veins over the length of the drift. The ore shoots are up to 100 feetlong. Gledhill (1929) states the best ore is accompanied by pink calcite in some places and in others by reddening of the diabase adjoining the vein. Also, according to Gledhill, disseminated cobalt is found in the aplite next to the calcite vein.

Alteration

In places along the side of the calcite veins are found patches of hematitic alteration, which can extend up to 3 inches away from the veins. The contacts between this alteration and the calcite veins is sharp. Annabergite and erythrite are also present as irregular patches in the country rock adjoining mineralized sections of the calcite veins. The number and extent of development of alteration zones in the diabase next to the calcite and aplite veins is variable. Invariably, however, there are dark well-defined chloritic(?) zones immediately adjacent to the calcite veins and usually the aplite veins; the aplite veins show sharp to relatively sharp contacts with altered, and what appears to be unaltered, diabase. Commonly following a dark zone there appears a brownish grey zone, approximately 1/2 inch wide, grading into a light steel-grey zone, also about 1/2 inch wide, that is gradational into a dark grey zone, that finally grades into the unaltered diabase.

Elsewhere, the three alteration zones may include a dark reddish grey zone, up to 1 1/2 inches wide, grading out into a grey to light grey zone, about 1 1/2 inches wide, that grades into a dark slightly red zone, about 5 to 5 1/2 inches wide, that finally grades into the unaltered diabase. In a few places, only a light coloured alteration zone, approximately 1 inch wide, follows the dark chloritic(?) zones. The chloritic(?) zones, besides occurring adjacent to the aplite and calcite veins, also occur between the calcite and aplite veins where they are close together. It is at present impossible to state if there are any chemical or mineralogic differences in the alteration zones occurring adjacent to the aplite or calcite veins.

Vein Systems

Vein System North of the Silverado Shaft

This system has been traced for 300 feet with its probable extension located 700 feet to the north. There are two distinct parallel veins, striking north 1 to 10 feet apart and 1 to 10 inches wide.

Main Hudson Bay System

The length is upwards of 1,100 feet and upon which Nos. 1, 2, and 3 shafts are located. The main vein structure strikes northeast and is thought by MacVeigh (1967)1 to be localized by the presence of a large aplite dike present in the southeasternmost drift on the 176-foot level. This system is parallel to the strike of the diabase sill.

Other cross-veins are present that appear to be independent of the aplite, however, most of the high-grade ore recovered to date (1968) has been found in the northeastern veins, with the junctions of the cross-veins with other veins being the loci of high-grade ore shoots.

Veins at No. 3 Shaft

These veins lie entirely within the Nipissing Diabase. Unlike the main Gowganda mines there are very few minor veins associated with the main ore vein. Individual veins vary from a fraction of an inch to 4 inches wide, showing great variability and relatively fast changes in width. As was previously stated the calcite veins can occur in the middle or on either side of the aplite dikes and in places cut across the aplite. Patches of what appears to be aplite occur in the calcite veins and calcite occurs in the aplite as stringers and 'eyes'. The calcite veins commonly show a rusty brown stain. In several locations on the 76-foot level one large calcite vein appeared to be made up of small veins with perfectly straight parallel contacts; each small vein was approximately 1/10 inch wide. On both levels the calcite veins contained a large amount of mafic inclusions (see Photo 6) when compared to those at the Siscoe or Castle-Trethewey Mines.

In summary, the main differences observed between the calcite veins at Rustex and the veins at the Siscoe and Castle-Trethewey Mines are:

1. The extreme variation in width, over short distances, of the veins at Rustex

2. The hematitic alteration of the wall-rock along the veins at Rustex

3. The crumbly nature of the veins at Rustex

4. The association of the veins at Rustex with aplite veins

5. The relatively large amount of mafic material present as inclusions in

the veins.

Aplite

Aplite dikes have been found in the Gowganda, Elk Lake, and Cobalt areas. Their width varies from less than l inch to l or 2 feet and seldom exceed a few hundred feet in length. They are found exclusively in the upper parts of the diabase sill. Mineralogically they are composed essentially of albite and quartz with accessory apatite, sphene, opaque iron oxide, zircon(?), and secondary chlorite. Their significance was underlined as a result of work done by Sampson and Hriskevich (1957) in the Cobalt area. They found:

1. Aplites are late stage differentiates of the magma from which the diabase was formed and from which the metallization was derived and thus should show a close spatial relationship to mineralization.

2. West of Bass Lake (in Cobalt area) the aplites are mineralized. It should be noted that at Cobalt the mineralization occurs within calcite in the centre of the aplite dikes, the calcite grading out into the aplite.

Characteristics of the Aplite at Rustex

As an aplite vein is traced along a drift it may occur on both sides of the calcite at any one location, or alternate from side to side along the length of the calcite vein. The width of an aplite vein can vary considerably over short distances from about 1/2 inch up to about 6 inches. Contacts between the aplite and the diabase can be sharp, gradational, irregular, to extremely straight. The contact can change its characteristics as the vein is traced along the drift. Unlike the calcite veins the aplite veins very seldom bifurcate. Minor disseminated metallic minerals have been observed in the aplite, but the identity, extent, and importance are unknown at the present. It can only be assumed they are of minor economic importance, although, according to G.Shartner, geologist from Haileybury (1968, personal communication), they are productive locally; for example in drifts 102 NE and 213 W. The contact between calcite veins and aplite dikes is always sharp, with the presence of a dark chloritic(?) zone separating the two in many places. The contact between the calcite vein, and the aplite dike and the dark alteration band is always sharp.

Origin of the Aplite and Mineralization

Sampson and Hriskevich (1957) determined the following sequence of events that took place at Cobalt to explain the occurrence of the aplite vein and the associated mineralization:

1. Crystallization of major portion of the aplite

2. Segregation of residual fluid rich in volatiles as the temperature decreased

3. Formation of albite and later quartz deposited

4. Crystallization of carbonate and metallic minerals with some replacement of the quartz and albite.

This sequence was suggested to explain the fact disseminated metallic minerals are present throughout the aplite proper as well as the fact calcite and metallic minerals are present in the medial parts of the veins. This sequence of events can be adjusted to account for the aplite and metallic minerals at Rustex by simply assuming the larger part of the metallic minerals and the aplite, although related, were introduced in two separate stages, not in one stage as at Cobalt.