REPORT ON GEOLOGICAL MAPPING
AND SAMPLING OF GOLD OCCURRENCES
on the
Goodall Property

Goodall Township
Red Lake Mining Division, Ontario

N T S  52 N/2

for
Black Cliff Mines Limited

Toronto, Ontario
November 1988

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Consulting Geologist
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Property Location and Access

The Goodall property of Black Cliff Mines Limited is located 50 miles east-northeast of Red Lake in the south central part of Goodall Township. A general location map is given in Figure 1. Access is by float or ski equipped aircraft. The aircraft can land on Washagomis Lake which is on the eastern border of the claim block. Boat access from the South Bay Mine along Confederation Lake and Washagomis Lake requires several portages.

Services and supplies can be obtained from Red Lake, a mining community with a population of 2000. A north-south running power line is located about 50 miles west of the claims.

Description of Property

The ten contiguous mining claims are located in Goodall Township in Kenora Mining Division, Patricia Portion. The total area of the claims is about 400 acres. The claim numbers and the recording and extension date of the claims are listed below. The location of the claims is given in Figure 2.

<table>
<thead>
<tr>
<th>Claim</th>
<th>Acres</th>
<th>Recording Date</th>
<th>Extension Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRL 509730</td>
<td>40</td>
<td>Nov 19/79</td>
<td>Dec 19/88</td>
</tr>
<tr>
<td>509731</td>
<td>40</td>
<td>Nov 19/79</td>
<td>Dec 19/88</td>
</tr>
<tr>
<td>509732</td>
<td>40</td>
<td>Nov 19/79</td>
<td>Dec 19/88</td>
</tr>
<tr>
<td>509733</td>
<td>40</td>
<td>Nov 19/79</td>
<td>Dec 19/88</td>
</tr>
<tr>
<td>509734</td>
<td>40</td>
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<td>Dec 19/88</td>
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<td>509735</td>
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<td>509736</td>
<td>40</td>
<td>Nov 19/79</td>
<td>Dec 19/88</td>
</tr>
<tr>
<td>509737</td>
<td>40</td>
<td>Nov 19/79</td>
<td>Dec 19/88</td>
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<tr>
<td>509738</td>
<td>40</td>
<td>Nov 19/79</td>
<td>Dec 19/88</td>
</tr>
<tr>
<td>509739</td>
<td>40</td>
<td>Nov 19/79</td>
<td>Dec 19/88</td>
</tr>
<tr>
<td>Total</td>
<td>400 acres</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

General Geology

The property is located within the Birch-Uchi greenstone belt. The Birch-Uchi belt is part of the Uchi subprovince which belongs to the Archean Superior Province of the Canadian Shield. The north trending belt of volcanic and sedimentary rocks is bounded on the south by the English River subprovince, which has a greater proportion of sedimentary rocks. The Swain Lake fault forms the northern boundary. On the west and east, the Birch-Uchi belt is bounded by granitic batholiths: the Trout Lake batholith to the west and the Okanse batholith to the east.

Three cycles of volcanism have been identified within the belt (Thurston 1985). Each volcanic cycle consists of a mafic base which grades into a felsic top. Marbles, cherts and iron
Figure 1: General location map, property as indicated (1:800,000).
formations cap Cycle I and Cycle II volcanics. Intermediate tuffs and felsic tuffs are the principal rock types of each volcanic cycle in their middle and top part respectively. The Goodall Township property of Black Cliff Mines Ltd. is underlain by Cycle III volcanics (see geological map by Thurston 1985). The north trending belt between Washagomis Lake and Women Lake is characterized by mafic volcanics (formation K of Cycle III). Formation K is characterized by dark to light green pillow basalts, minor pillow breccias, massive basalt flows and by white weathering mafic volcanics which are also white or greenish white colored on fresh surface. The light color of mafic volcanics is attributed to intensive epidotic alteration and moderate to weak carbonate alteration. The alteration extends over large areas. It is thought to be the result of seafloor fumarolic activity (Thurston 1985). When pillows are not present, the greenish grey to white colored mafic volcanics can be distinguished from rhyolites by the lack of conchoidal fracture and by the lack of quartz in the weathered rind.

The massive basalt flows of formation K have an ophitic to intergranular or isogranular texture. Variolitic massive flows occur about 500 meters above the base of formation K. The upper part of Cycle III volcanic sequence characterized by felsic flows and tuffs is not present in the area of the Goodall property.

Geochronological data indicates that the three cycles of volcanism differ in age by as much as 100 million years.

Metamorphosed felsic to intermediate hypabyssal intrusions intrude into the volcanic-sedimentary sequence. Hornblende-quartz diorite and granophyric granodiorite form small to medium size stocks. Quartz feldspar porphyritic rhyolite dykes and stocks are associated with felsic volcanics at the top part of Cycle III. Unmetamorphosed felsic to intermediate intrusions form four large bodies of batholithic dimensions in the general area of Confederation Lake.

The regional structure is characterized by a south trending synclinorium and a parallel trending anticlinorium. The axes of the syncline runs east of Washagomis Lake. Although deformation zones of regional nature were not recognized in the general area of the property, narrow shear zones of 1 to 2 kilometers length were mapped by the Ontario Geological Survey near the west shore of Washagomis Lake. The 1 to 2 meter wide shear zones strike NW and NE (Fyon and Donnel 1986). These shears would presumably extend into mineral claims KRL 509735, 737 and 739 of the Goodall Property (Figure 057.1 in Fyon and Donnel 1986).

In the Washagomis-Woman Lakes area, the hydrothermal alteration of sheared mafic volcanic rocks is characterized by chloritization and carbonitization. Both ferrous dolomite and
calcite were noted (Fyon and Donnel 1986). The carbonates are accompanied by variable amounts of sericite and sulfide minerals. In general, quartz veins are not common. They appear to be more frequent in the chloritized shear zones. These quartz veins contain no significant amounts of gold or sulfide minerals.

In the Uchi Confederation area in the past producing gold mines, the mineralization was associated with quartz and quartz carbonate veins localized along shear and fracture zones within the volcanic rocks. At the Uchi Mine which is located about 11 miles SE from the Goodall property, pyritic quartz-carbonate veins occurred at the contact of intermediate metavolcanics with felsic pyroclastics and cherty tuffs. From 755,000 tons of ore grading 0.15 oz/t Au, 114,467 oz gold was produced. In the Hudson Patricia Mine located 2 miles south of the Goodall property, the mineralized quartz veins were hosted by altered (sheared?) mafic volcanics and intrusive quartz porphyry. At this mine, 11,228 tons of ore produced 1,857 oz gold. A number of smaller prospects in the general area produced a few hundred ounces of gold each.

The South Bay Mine, a past producer of base metals from a volcanogenic massive sulfide orebody, is located about 10 miles SSE of the Goodall Property.

Previous Exploration Work

An excellent summary of the previous exploration work is given by Willoughby (1987) in a report to Black Cliff Mines Limited. In this report only a brief summary of the previous work is given. The earliest gold exploration on these claims was carried out in 1928. Williams (1928) as quoted by Swanson (1985), reported some good gold values from trenching and drilling.

In 1939 Mr. Ben Rouillard carried out trenching and sampling SE of the current Goodall claims (File 2.3754, OGS p. 1216). Gold assays ranging from 0.01 to 1.86 oz/t were reported by Mr. Rouillard.

In the period 1958 to 1961, Madsen Red Lake Gold Mines Ltd. completed trenching and sampling. Twenty three samples were collected from sixteen trenches and pits (File 2.3754 OGS) from a shear zone which later became known as Zone 1 of Minorex Ltd. Nearly all samples contained anomalous concentrations of gold. The best chip sample assayed 0.08 oz/t Au over 5.8 feet. A grab sample contained 0.15 oz/t Au. In another area which later became known as Zone 3 of Minorex Ltd., a six foot wide shear was sampled by Madsen Red Lake Gold Mines Ltd. The best grab samples assayed 1.0 and 1.8 oz/t Au from a 5 cm wide part of the zone. Chip samples assayed less than 0.06 oz/t Au. Drill hole 1959-1 of Madsen Red Lake Mines intersected 15 feet of 0.046 oz/t Au from the vicinity
of Zone 1.

In 1969 Falconbridge Nickel Ltd. carried out an airborne electromagnetic survey and detected low order EM conductors in the NW corner of the property. In 1971 Falconbridge completed ground EM surveys (Afmag-Aflec system) and outlined three EM anomalies.

Minorex Ltd. carried out the most extensive exploration program on the property. Minorex carried out geological mapping, sampling of old trenches, VLF and horizontal loop EM surveys and diamond drilling. The trenches and pits were located along five separate shear zones (Zone 1 to Zone 5). Grab samples from various shears gave the following results:

Shear 1: Ten samples taken from this zone assayed from 0.02 to 1.55 oz/t Au. The average value is between 0.05 and 0.1 oz/t Au.
Shear 2: Two grab samples assayed 0.36 and 0.60 oz/t Au.
Shear 3: One sample assayed 0.54 oz/t Au.
Shear 4: Two samples contained 0.07 and 0.04 oz/t Au.
Shear 5: Three grab samples assayed 3.12, 1.32 and 0.13 oz/t Au.

In 1980 Minorex Ltd. completed five drill holes totalling 761 feet. These drill holes tested Zone 1 (see compilation map for the location of drill holes). In 1981 seven more drill holes totalling 1029 feet were completed. The best drill hole intersections are listed in Table 1.

<table>
<thead>
<tr>
<th>Drill Hole #</th>
<th>Depth</th>
<th>Length of Intersection</th>
<th>Grade (oz/t Au)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-80-1</td>
<td>109-118'</td>
<td>9'</td>
<td>0.06</td>
<td>Intensive silicification over 30'. Brecciation.</td>
</tr>
<tr>
<td>G-80-5</td>
<td>159'</td>
<td>about 2'</td>
<td>0.05</td>
<td>Two separate shears 1) Carbonate altered 2) Quartz-carbonate veined, Contains more Au than 1.</td>
</tr>
<tr>
<td>G-81-6</td>
<td>130.7-133.2</td>
<td>2.5'</td>
<td>0.07</td>
<td>Zone with 5-10% quartz-feldspar veins.</td>
</tr>
</tbody>
</table>
It was noted that the shears are just as well defined at depth as on the surface. The average width of the shears varies from 3 to 6 feet. Some zones are about 10 feet wide. Both ductile and brittle shears were intersected by the drill holes. Some drill holes cut two separate shears (e.g. hole G-80-5). In general, quartz-carbonate veining is only moderately developed. Quartz carbonate veins which replace the wallrock are wider. Apart from the quartz and carbonate veins, quartz-feldspar veins were described from drill hole G-81-6. The different mineral assemblage of the vein may be the result of a higher temperature of deposition.

Alternatively, it is possible that the quartz-feldspar veins are in fact recrystallized cherts with a few percent of feldspar fragments. The HST "quartz vein," which extends for nearly 3 km strike-length in the vicinity of the Uchi Gold Mine, on close examination proved to be a recrystallized chert which contains 10 to 20% albite and carbonate (Thurston 1985, page 29). The Cycle II basalts host several gold occurrences along strike with the Hill-Sloan-Tivey chert (Thurston 1985, page 96).

Some of the VLF EM anomalies detected by the Minorex Ltd. survey partially coincide with known shear zones. The weak horizontal loop EM anomalies located at the NW part of the property have no apparent explanation.

In 1985 Dome Exploration Ltd. examined the Washagomis Lake property (R. Swanson 1985, internal company report for Dome Exploration Ltd.). Each of the gold occurrences sampled by Dome Exploration Ltd. were previously drilled by Minorex Ltd. in 1981. Trenches and pits in the vicinity of drill holes G-80-1 to G-80-5 (Shear 2) were sampled most extensively. The property examination by Dome Exploration verified that shears can be traced on the surface for over 300 meters. Shears in the vicinity of drill holes G-81-8 (Shear 1) and G-81-10 (Shear 3) were sampled less extensively by Dome. Of the 25 samples taken, the best grab
samples assayed 0.1, 0.2 and 2.5 oz/t Au. The very high gold value was from Shear 3. At this locality, drill hole G-81-10 intersected 2 oz/t Au over 27 cm length of core. Chip sampling of trenches yielded less favourable results than the grab samples. Chip samples taken over 2 to 5 feet width assayed 0.02 to 0.08 oz/t Au.

In 1987 Black Cliff Mines Limited carried out linecutting, preliminary geological mapping and limited sampling of old trenches. Zone 1 of Minorex Ltd. was traced for a strike length of 2000 feet. Sampling verified the presence of subeconomic concentrations of gold in the majority of samples collected from shear zones. Five grab samples out of the 25 samples collected from trenches assayed 0.1 to 3.2 oz/t Au. The highest gold values were from 3 to 5 cm wide quartz veins. Anomalous concentrations of arsenic and possibly mercury are associated with the gold.

VLF EM survey and magnetometer survey were also carried out by Black Cliff Mining (Hlava 1987). In the area of the Minorex Ltd. drill holes, Zone 1 has a coincident VLF EM anomaly. Few VLF anomalies coincide with local magnetic highs.

**Exploration Program**

The 1988 exploration program included geological mapping and sampling. The program was carried out during the period Sept 18 to Oct 2. The mapping was done on a 1:2500 scale. Topographic control was provided by a metric grid with lines cut at 100 meter intervals and stations picketed at 25 meter spacing.

The following persons carried out the work:

Arpad Farkas, Ph.D., Toronto  
Viera Kovac, B.Sc., Windsor  
Paul Caraccio, B.Sc., Ottawa

In addition to doing geological mapping, the writer also supervised the junior geologists. A total of 31 rock samples were analyzed for gold. Ten of these samples were taken from old trenches. The remainder of the samples were collected from outcrops of more sulfide-rich or sheared volcanics.

**Results of Geological Mapping and Sampling**

**Description of Map Units**

The rocks were classified into the following map units:

1a Massive fine grained basalt  
1b Pillowed basalt
Dioritic to gabbroic textured massive flows
Id Amygdaloidal basalts
Ie Mafic flow breccias and pillow breccias
lf Variolitic to spherulitic intermediate to acidic flows
2a Felsic crystal tuff and cherty tuff
2b Mafic tuffs
2c Chert
3a Gabbro to diorite
3b Diorite
3c Quartz diorite to tonalite.

The most widespread rocks are pillow lavas and massive basalt flows. Some of the massive and pillowed basalts altered, pale green colored, bleached. The amygdaloidal basalts contain chlorite, less commonly quartz-filled amygdules. In a few cases pyrite and pyrrhotite-filled amygdules were noted.

The outcrops are rarely suitable for the determination of pillow facings. The few observations suggest that the southerly dipping pillows are in an upright position. At one locality (9+75W, 2+25S) the northerly facing pillows appear to be overturned.

At a few localities mafic flow breccias outcrop. The breccias are characterized by round or ameboid shaped fine green colored basalt fragments which occur in a dark green, chloritized hyaloclastite matrix. Locally fragments of pillows can be recognized. The pale green colored flow breccias are moderately bleached and epidotized.

Silicification of mafic flows was rarely noted. Generally the silicification is more noticeable in the vicinity of chert beds. The more intensively altered massive basalts are white weathering and have a light greenish grey color on fresh surface. The alteration is mostly due to epidotization. These lighter colored basalts were mapped as intermediate volcanics by Minorex Ltd.

Variolitic or spherulitic flows are common in the northern part of the property. Feldspar, quartz and zoizite or epidote can be recognized in varioles. The varioles have a diameter of l mm to 1 cm. Their amount ranges from 10 to 80%. The dark green colored mafic looking vaiolitic rocks may have intermediate or even basaltic composition. Lighter green colored more felsic looking spherulitic flows probably have an acidic composition (see results of whole rock analysis). The variolitic flows have a northeasterly trend.

Dioritic to gabbroic textured massive basalt flows occur west of MacDonald Lake (8+50W, 1+50S and 12+00W, 2+00S). The grain size of these coarser grained flows varies from 1/2 to 1 mm. The
texture varies from subophitic to equigranular. At one locality (8+50W, 1+50S) transition from medium grained gabbroic rocks to fine grained amygdaloidal basalts can be observed.

Dioritic to gabbroic textured bodies mapped elsewhere are interpreted to be intrusive. The intrusive bodies are 50 to 100 meters in diameter. The lack of gradational textures between fine grained and gabbroic textured rocks suggest that these bodies are intrusives.

Narrow NW to NE trending diorite dykes and sills intrude the basalts. The Nk trending dykes strike Az 45 to Az 70. At 10+75W, 4+00S the texture of the dyke varies from dioritic to feldspar porphyritic. Possibly this is a subvolcanic dyke which was feeding the overlying Cycle III andesite flows. In general the dykes have a short strike length.

Dark grey colored to nearly black colored fine grained quartz diorite or tonalite is associated with some of the gabbroic intrusives. These rocks contain 1 to 3% of fine grained smoky or dark grey colored quartz. Plugs and small stocks of quartz diorite occur in the NW part of the map area. The diameter of these intrusives ranges from 10 to 100 meters.

Crystal tuffs of felsic composition as well as cherty tuffs occur in the SW part of the claim block. The tuff is characterized by 30 to 60% white feldspar fragments which occur in an aphanitic or very fine grained grey colored siliceous matrix. The feldspar fragments range in diameter from 1/4 to 2 mm. When a low proportion of feldspar fragments is present, the rock has a cherty appearance. At 11+00W, 4+12S the contact of crystal tuff and basalt is exposed. The contact is sharp without any change in the grain size of the feldspars. The strike of the contact is Az 60. Definitely the contact is not intrusive in nature. The felsic tuffs are locally associated with cryptocrystalline, dark, greenish grey colored white weathering cherts (10+00W, 4+50S). At this locality, cherty tuffs with less than 20% feldspar fragments can also be seen.

At the localities where the crystal tuffs outcrop, the thickness of the beds is estimated to be 5 to 10 meters. Despite the significant thickness, the beds appear to have a short strike length (probably in the order of 100 to 200 meters). The short strike length may be due to poor preservation, slumping of beds, accumulation in topographic lows, etc.

Chert beds and chert lenses of very short strike length occur in the sequence of mafic volcanics. At 12+15W, 2+06S a chert lense with dimensions of 2 m x 12 m is entirely enclosed within massive mafic flows. The top (?) contact of the chert with the gabbroic textured flow is sharp. The underlying (?) finer grained flow is
silicified near the contact. At 10+00W, 1+40S intensive silicification of basalt is noted adjacent to the chert. Sulfides are not associated with the exhalative chert. There is no evidence of quartz veining or other signs of intensive hydrothermal activity near the chert outcrops.

Fine grained mafic tuffs outcrop at a few places. At 11+00W, 10+18S a one meter wide bed of fine grained well foliated mafic tuff is in contact with an intermediate variolitic flow or tuff. This unit also has a limited strike length of 100 to 200 meters.

Structural Geology

In the SW part of the property, the best indicators of bedding, felsic tuff and chert beds strike Az 60. The strike of variolitic flow units in the northern part of the property is about Az 60 to 70. Flattened pillows also strike in the same direction. However, to some extent, this can be attributed to the tectonic deformation of pillows.

The regional trend of bedding in the Confederation Lake area is northerly to northeasterly (Thurston 1985). The more easterly bedding observed on the Goodall property is interpreted to be the result of large scale open folding. The strike of regional foliation in the Confederation Lake area varies from NE to E (Thurston 1985). Similar striking foliation was observed in the area of the Goodall property. The most common foliation strikes Az 70. The foliation steeply dips towards south.

One to two meters wide shear zones cut the volcanic and intrusive rocks. The strike of the shear zones varies from Az 50 to Az 90. The Az 70 to Az 80 striking shears are the most common. There is no evidence of displacement along the shears. Well foliated rocks are confined to the shear zones. Minor quartz veining and more significant carbonate veining took place in a direction parallel to the boundaries of the shears. Replacement veins in carbonate altered shears are characterized by rusty weathering ankerite. The sheared volcanics exhibit varying degrees of chloritization and sericitization. The thin quartz veins and quartz stringers pinch and swell. No replacement of wall rock is noticeable along the quartz veins.

A small scale fault striking Az 20 was noted at 10+00W, 1+12S. Along this steeply dipping fault, the eastern block moved north relative to the western one. Evidence for large scale faulting was not seen.

Drill holes completed by Minorex Ltd., geophysical anomalies, gold occurrences and shear zones are plotted in a compilation map (Map 2 of this report). The drill hole locations are from the
geological map of Minorex Ltd. More detailed maps of Minorex which also give the drill hole locations appear to be inaccurate. (Probably the grid lines were mistakenly numbered on these maps.) Some of the old drill set ups were located in the field. The relationship of Minorex Ltd.'s grid to the present grid is given in Figure 3.

A long E-W striking VLF EM anomaly trends across the Minorex drill holes (Map 2 of this report). By and large, this VLF anomaly coincides with Zone 1 of Minorex. The interpreted shear on the geological map (Map 1 of this report) was in part based on the VLF and drill hole data. Nevertheless, it has to be mentioned that the strike of shear zones observed in pits with gold mineralization in the area of drill holes appears to be about Az 70 to Az 75 rather than EW. The apparent discrepancy is probably due to the presence of more than one shears which are subparallel or have an enechelon arrangement.

There are many shorter NE trending VLF EM anomalies on the property. These may correspond to shears, flow contacts or contacts of intrusives with volcanics.

The best IP anomaly extends over 200 meters between lines 5+00W and 7+00W (Map 2 of this report). Pale green altered bleached basalts outcrop around the west end of the IP anomaly. Several other IP anomalies of shorter strike length occur on the property. Zone 1 of Minorex Ltd. does not have a coincident IP anomaly.

Results of Sampling and Assaying

Four samples were collected for whole rock analysis. Description of the samples and the results of chemical analysis are included in the Appendix. Sample 16164, a pale green altered pillowed flow, was taken in order to check the possibility that these flows have andesitic composition. The chemical data indicates that the flow has a basaltic composition. The basalt has undergone moderate leaching of sodium. The 1.7% sodium oxide content is much lower than the comparable value for the average oceanic tholeiite (about 2.6%).
ORIENTATION OF MINOREX LTD. GRID
TO BLACK CLIFF MINES LTD. GRID

LEGEND
— MINOREX LTD. GRID
--- BLACK CLIFF MINES LTD. GRID
△ CLAIM POST
-- CLAIM LINE

figure 3
A variolitic or spherulitic dark green colored flow (sample 18163) has a rhyolitic composition. The low titanium and magnesium content of the rock negates the possibility that it is a silicified basalt. The dark green color is due to chloritization. During the cooling of the flow, the glassy groundmass of the rhyolite reacted with seawater and chloritized. It is likely that all the spherulitic somewhat more siliceous looking flows are intermediate or acidic in composition. More whole rock analysis would be needed to elucidate this question.

Chemical analysis of a rock mapped as quartz diorite (sample 18165) results in a higher silica content (63%) than that of a quartz-rich diorite. The chemical composition would suggest a tonalite. Since the typical samples from this type of rock do not contain more than 5% quartz, probably both quartz diorite and tonalite are present in the map area. The tonalite has an unusually high iron content (13.9% total iron expressed as ferric oxide). This is due to fine grained disseminated magnetite.

One sample of felsic crystal tuff (sample 18166) has a rhyolitic to dacitic composition.

Mineralization and Host Rock Alteration

The alteration along shear zones terminates abruptly within or close to the boundaries of the shears. The exceptions are carbonate-rich shear zones in which the carbonate alteration may extend beyond the boundaries of the highly deformed rocks over a distance of few meters. In carbonate-rich shear zones, ankerite and calcite replace the wall rocks. Minor pyrite, chlorite and sericite is associated with the carbonates.

In general, quartz veins are not as well developed as carbonate veins or quartz-carbonate veins. Some of the thin quartz veins and stringers contain high grade gold mineralization. The wider carbonate zones contain much lower grade gold mineralization.

Except for narrow localized sulfide-rich ore shoots, the sulfide content of known shear zones is quite low. Therefore these are not expected to have coincident IP anomalies. The IP anomalies detected may belong to more sulfide-rich shears.

Although some good grade gold mineralization is present locally over narrow widths, the overall grade of the shear zones is low. Nevertheless, the subgrade ore zones, intersected over 9 to 15 feet length by drilling, warrant further exploration.
Some of the altered, pale green colored basalts may have undergone hydrothermal alteration related to the deposition of gold. Lithogeochemical survey of these types of rocks may outline prospective areas.

Due to the lack of time, only very little prospecting was done during the present exploration program. Although Minorex Ltd. carried out more thorough prospecting, not all the old gold showings were found. A 1935 report on the Hurley claims (O.G.S. file), which covers the entire area of the present claim block, outlines more gold occurrences than what was found by Minorex Ltd. In order to find all the old gold occurrences, a program of more detailed prospecting is recommended.

Conclusions and Recommendations

1. The property is underlain by mafic and intermediate to acidic flows. Small stocks and dykes of late intrusives which include gabbro, diorite and quartz diorite to tonalite intruded the volcanic pile.

2. Gold mineralization occurs in Az 70 to Az 90 trending shear zones which are 1 to 2 meters wide. Wider mineralized breccia zones known from previous drilling also contain gold.

3. Quartz-carbonate veins and discontinuous thin quartz veins occur in the shear zones parallel to the strike of the shears. The carbonate veins are better developed than the quartz veins. The host rock alteration is characterized by ankerite, chlorite and minor sericite. Apart from local pyrite and arsenopyrite-rich ore shoots, the overall sulfide content of the known shears is low.

4. Although some good grade gold mineralization is present locally in narrow widths of 10 to 20 cm, the overall grade of the shear zones is low. Nevertheless, the presence of local high grade gold intersections (e.g. Minorex drill hole G-81-10) and subgrade ore zones of more significant apparent width (0.05 oz/t Au over 9 to 15 feet length of core) are encouraging and warrant further exploration. There is a reasonably high probability of finding a smaller economic grade gold deposit on the property.

5. The more extensive IP anomalies, which may be related to sulfide-rich shears, should be tested by diamond drilling.

6. In order to find all the gold occurrences outlined by past exploration, a program of more detailed prospecting is recommended.
7. A total of 5000 feet of diamond drilling is recommended:
   
a. 2500 feet of drilling to test the best IP anomalies
b. 2500 feet of drilling on known shear zones. This would include further testing the shear intersected by Minorex drill hole G-81-10 (1.82 oz/t Au over 0.9 feet length).

Further testing of Zone 1 along strike is recommended. Possible drill targets also include any additional showings found by prospecting.

5,000 feet of diamond drilling = $150,000

The cost of $30 per foot drilled includes mobilization and demobilization by helicopter and drill moves by helicopter.

Toronto, Ontario
November 1988

Arpad Farkas, Ph. D.
Consulting Geologist
CERTIFICATE OF QUALIFICATION

I, Arpad Farkas of the City of Toronto, in the Province of Ontario, Canada, hereby certify:

1. That I am a consulting geologist and have been engaged in my profession for approximately ten years full-time and five years part-time.

2. That I am a graduate of the Eotvos Lorand University, Budapest, Hungary, with a B.Sc. degree in geology (1968); of the University of Alberta, with an M.Sc. degree in geology (1973); and of the University of Toronto, with a Ph.D. degree in geology (1980).

3. That my knowledge of the property described was acquired during visits to the property in 1988 and from the study of the publications and reports cited in the present document.

4. That I have no interest, either direct or indirect, nor do I expect to receive any interest, in the properties or securities of Black Cliff Mines Limited.

5. That I hereby consent to the use of this report by Black Cliff Mines Limited for its corporate purposes.

Dated at Toronto, Ontario, this 15th day of November, 1988.

Arpad Farkas
## APPENDIX A

### SAMPLE DESCRIPTION

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Location</th>
<th>Description</th>
<th>Au Assay Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>18136</td>
<td>8+00W; 5+70S</td>
<td>Carbonate veined mafic volcanic from old trench (ankerite veinlets of 2 cm width); trace chalcopyrite</td>
<td>541 ppb</td>
</tr>
<tr>
<td>18137</td>
<td>8+00W; 5+70S</td>
<td>Quartz veins from mafic volcanic old trench, minor pyrite</td>
<td>4025 ppb</td>
</tr>
<tr>
<td>18138</td>
<td>9+05W; 1+50S</td>
<td>Quartz carbonate veined mafic volcanics</td>
<td>159 ppb</td>
</tr>
<tr>
<td>18139</td>
<td>4+00E; 4+75N</td>
<td>Pillowed intermediate volcanics trace pyrite, minor carbonate, green quartz blebs</td>
<td>19 ppb</td>
</tr>
<tr>
<td>18140</td>
<td>3+20E; 3+25N</td>
<td>Siliceous intermediate volcanics 1-2% sulphides (pyrite ?)</td>
<td>52 ppb</td>
</tr>
<tr>
<td>18141</td>
<td>2+00E; 3+10N</td>
<td>Pillowed intermediate volcanics with 1 m wide shear zone, strong carbonate, 1% rusty patches</td>
<td>21 ppb</td>
</tr>
<tr>
<td>18142</td>
<td>1+85E; 4+00N</td>
<td>Pillowed, sheared intermediate volcanics, trace arsenopyrite, minor carbonate</td>
<td>39 ppb</td>
</tr>
<tr>
<td>18143</td>
<td>2+00E; 2+00N</td>
<td>Intermediate volcanics 1% sulphides (pyrite ?) 3-5% epidote stringers</td>
<td>112 ppb</td>
</tr>
<tr>
<td>18144</td>
<td>1+00E; 0+50S</td>
<td>Intermediate volcanic</td>
<td>68 ppb</td>
</tr>
<tr>
<td>18145</td>
<td>1+00E; 0+15S</td>
<td>Intermediate volcanic (possibly pillowed), trace pyrite</td>
<td>20 ppb 18 chk</td>
</tr>
<tr>
<td>18146</td>
<td>1+10E; 1+30N</td>
<td>Intermediate volcanics, trace pyrite</td>
<td>21 ppb</td>
</tr>
<tr>
<td>18147</td>
<td>1+00E; 3+90N</td>
<td>Aphanitic intermediate volcanics 1% arsenopyrite</td>
<td>13 ppb</td>
</tr>
<tr>
<td>18148</td>
<td>0+00; 0+65N</td>
<td>Sheared intermediate volcanics trace sulphides (pyrite ?) strong carbonate</td>
<td>20 ppb</td>
</tr>
<tr>
<td>18149</td>
<td>0+05W; 4+15N</td>
<td>Sheared, pillowed intermediate volcanics, trace sulphide (pyrite) strong carbonate, 3-5% sericite</td>
<td>65 ppb</td>
</tr>
<tr>
<td>18150</td>
<td>0+30W; 2+25N</td>
<td>Sheared, pillowed intermediate volcanics, strong carbonate</td>
<td>20 ppb</td>
</tr>
<tr>
<td>18151</td>
<td>1+00W; 5+20N</td>
<td>Fine grained, mafic tuff trace 1% pyrrhotite</td>
<td>30 ppb</td>
</tr>
<tr>
<td>18152</td>
<td>1+00W; 4+70N</td>
<td>Intermediate volcanics trace 1% pyrrhotite trace chalcopyrite, minor carbonate</td>
<td>14 ppb</td>
</tr>
<tr>
<td>18153</td>
<td>0+95W; 0+75N</td>
<td>Sheared intermediate volcanics minor carbonate, 1-3% sericite</td>
<td>29 ppb</td>
</tr>
<tr>
<td>18154</td>
<td>1+00W; 0+85N</td>
<td>Sheared intermediate volcanics trace pyrite, moderately strong carbonate</td>
<td>21 ppb</td>
</tr>
<tr>
<td>18155</td>
<td>6+35W; 5+05N (Trench)</td>
<td>Fine grained diorite near shear zone</td>
<td>14 ppb</td>
</tr>
<tr>
<td>18156</td>
<td>3+00W; 1+30N</td>
<td>Intermediate volcanic, intensive carbonate veining and silicification</td>
<td>18 ppb</td>
</tr>
<tr>
<td>18157</td>
<td>6+00W; 5+00N (Pit)</td>
<td>Quartz vein with pyrite and aresenopyrite (20% prismatic crystals)</td>
<td>5867 ppb</td>
</tr>
<tr>
<td>18158</td>
<td>6+35W; 5+05N (Trench)</td>
<td>Sheared diorite, chloritic</td>
<td>54 ppb</td>
</tr>
<tr>
<td>18159</td>
<td>7+05W; 0+80S</td>
<td>Sheared carbonate altered chloritized mafic volcanics rusty weathering, ankerite veins minor trace pyrite</td>
<td>33 ppb</td>
</tr>
<tr>
<td>18160</td>
<td>7+05W; 0+80S</td>
<td>Sheared carbonate altered mafic volcanics</td>
<td>27 ppb</td>
</tr>
<tr>
<td>18161</td>
<td>7+20W; 0+80S</td>
<td>Sheared carbonate altered mafic volcanics</td>
<td>24 ppb</td>
</tr>
<tr>
<td>18162</td>
<td>6+00W; 5+00N (Large pit)</td>
<td>Sheared gabbro or gabbroic greenstone, carbonate altered moderately chloritized 3-5% sulphides (pyrite &amp; aresenopyrite)</td>
<td>3924 ppb</td>
</tr>
</tbody>
</table>
| 18167 | 2+05E; 5+60N | Barren quartz-carbonate vein (3-20 cm wide) in a pillowed intermediate volcanic | 16 ppb | 16 chk
Whole Rock Analysis

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18163</td>
<td>7+00W; 0+50S</td>
<td>Variolitic intermediate volcanics</td>
</tr>
<tr>
<td>18164</td>
<td>B10; 1+50W</td>
<td>Pillowed, pale green altered mafic volcanics</td>
</tr>
<tr>
<td>18165</td>
<td>7+75W; 4+60N</td>
<td>Quartz diorite, 1% smoky black colored quartz</td>
</tr>
<tr>
<td>18166</td>
<td>11+10W; 3+15S</td>
<td>Crystal tuff; 30% white feldspar fragments in a fine ash matrix</td>
</tr>
</tbody>
</table>
## Whole Rock Analysis

<table>
<thead>
<tr>
<th>Type</th>
<th>Variolitic Flow</th>
<th>Pale Green Basalt</th>
<th>Quartz Diorite</th>
<th>Crystal Tuff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>18163</td>
<td>18164</td>
<td>18165</td>
<td>18166</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>10.8%</td>
<td>16.8%</td>
<td>11.4%</td>
<td>14.2%</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>6.48%</td>
<td>12.5%</td>
<td>13.9%</td>
<td>4.25%</td>
</tr>
<tr>
<td>CaO</td>
<td>1.58%</td>
<td>12.4%</td>
<td>3.32%</td>
<td>1.53%</td>
</tr>
<tr>
<td>LOI</td>
<td>2.15%</td>
<td>2.95%</td>
<td>3.05%</td>
<td>1.65%</td>
</tr>
<tr>
<td>MgO</td>
<td>1.24%</td>
<td>7.96%</td>
<td>1.59%</td>
<td>1.53%</td>
</tr>
<tr>
<td>MnO</td>
<td>0.1%</td>
<td>0.2%</td>
<td>0.25%</td>
<td>0.04%</td>
</tr>
<tr>
<td>Na₂O</td>
<td>3.58%</td>
<td>1.75%</td>
<td>3.64%</td>
<td>5.61%</td>
</tr>
<tr>
<td>SiO₂</td>
<td>72.1%</td>
<td>46.1%</td>
<td>63.00%</td>
<td>68.5%</td>
</tr>
<tr>
<td>K₂O</td>
<td>0.9%</td>
<td>0.15%</td>
<td>0.42%</td>
<td>0.82%</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>0.13%</td>
<td>0.1%</td>
<td>0.58%</td>
<td>0.06%</td>
</tr>
<tr>
<td>TiO₂</td>
<td>0.46%</td>
<td>0.73%</td>
<td>1.57%</td>
<td>0.34%</td>
</tr>
<tr>
<td>Ba</td>
<td>174 ppm</td>
<td>46 ppm</td>
<td>108 ppm</td>
<td>220 ppm</td>
</tr>
<tr>
<td>Sr</td>
<td>78 ppm</td>
<td>251 ppm</td>
<td>119 ppm</td>
<td>104 ppm</td>
</tr>
</tbody>
</table>

Method Used: 1CAP
REFERENCES


INDUCED POLARIZATION SURVEY
BLACK CLIFF MINES LTD.
GOODALL PROPERTY
RED LAKE, ONTARIO

October 1988
CONTENTS

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I - INTRODUCTION

During the month of September 1988, an induced polarization survey was undertaken on the Goodall property (Red Lake area), in an attempt to outline stratigraphic horizons of disseminated sulphides.

The survey was carried out within the framework of an extensive exploration program implemented to evaluate the gold-bearing potential of this particular area.

II - PROPERTY

The Goodall property consists of ten (10) claims straddling the Goodall Twp. The claims covered by the induced polarization survey are numbered as follows:

BLACK CLIFF MINES LTD. (GOODALL PROPERTY)

Claims #

| KRL- 509730 | 509735 |
| 509731     | 509736 |
| 509732     | 508737 |
| 509733     | 709738 |
| 509734     | 709739 |

III - LOCATION & ACCESSIBILITY

The Goodall property could be reach from Red Lake, Ontario, by fixed-wing float-equipped aircraft east about 54 miles.

IV - INDUCED POLARIZATION SURVEY

The dipole-dipole induced polarization survey was carried out over a 100 meters grid line system. The grid consists of 12,6 Km
of induced polarization survey.

The electrode interval was 25 meters and voltage readings were taken from N=1 to N=4 at every 25 meters.

The .25 and 4.0 HZ frequencies were used during the survey. A Phoenix I.P. T-1 transmitter and I.P. V-1 receiver was used to carry out the survey.

V- DATA PRESENTATION

The maps and pseudo-sections of the calculated apparent resistivities and percentages of frequency effect are included in the book attached to this report.

Goodall property (Grid) Line 4+00 E to 12+00 W.

Three (3) sets of maps are included in the report:

1) Surface projection of interpreted I.P. anomaly zones;
2) Surface projection of interpreted I.P. anomaly zones, with resistivity N=4;
3) Surface projection of interpreted I.P. anomaly zones, with F.E. N=4.

Finally, apparent resistivity, frequency effect and metal factor pseudo-sections are presented in this book.

VI- DISCUSSION & INTERPRETATION

The induced polarization method is mainly used to detect disseminated metallic sulphides. The frequency effect is derived from a normalized difference of apparent resistivities calculated at two different frequencies. The frequency effect anomaly intensity is related mainly to the total surface of disseminated sulphide grains, the percentage of disseminated sulphides in the rock and the sulphide grain size.
Numerous complex anomalous patterns have been observed from obtained data. Examination of the sections reveals eight (8) anomalous zones.

**Anomalous zone #1**

Anomalous zone #1, on line 11+00 W between 3+75 S to 4+25 S, shows an increase of F.E. of up to 8.6% in a high resistivity of about 10,000 to 20,000 Ohm-meters. Only show on one (1) line.

**Anomalous zone #2**

Anomalous zone #2, on line 5+00 W, between BL. to 0+50 N, high resistivity zone 10,000 to 12,000 Ohm-meters with a high F.E. of about 9.0% to 10.5%.

**Anomalous zone #3**

Anomalous zone #3, between line 5+00 W to 7+00 W. Line 7+00 W between 1+25 N to 1+50 N. This line shows a weak response in F.E., low resistivity with an increase in metal factor. Line 5+00 W and 6+00 W. Both line show good I.P. response in the F.E. of up to 10.0% to 12.0% in a lower resistivity at 1+50 N to 2+00 N on line 5+00 W and 1+25 N to 1+75 N on line 6+00 W. Best line to drill is line 6 W between 1+25 N to 1+75 N.

**Anomalous zone #4**

Anomalous zone #4, from line 1+00 W to 2+00 W at station 0+25 N to 0+75 N on line 1+00 W and on line 2+00 W between 0+50 N to 0+75 N. Line 1 W shows high F.E. of about 7.0% at the contact of a high resistivity zone of about 30,000-40,000 Ohm-meters. Line 2 W a lower resistivity of about 600 to 1,000 Ohm-meters with a F.E. of about 1.8%. Line 2 W is the best line for a drill hole between 0+50 N to 0+75 N.
Anomalous zone #5

Anomalous zone #5, on line 1 W at 3+15 N to 3+50 N, is a weak response in conductivity, low resistivity with an increase in metal factor, F.E. around 1.2 to 1.4%. A close check at the outcrop on the side of the hill for shear zone (low resistivity).

Anomalous zone #6

Anomalous zone #6, on line 0 between 4+75 N to 5 N, shows an increase in F.E. of up to 6.5% in a lower resistivity.

Anomalous zone #7

Anomalous zone #6, on line 0 between 5+15 N to 5+50 N. A zone of lower resistivity with an increase in F.E. of up to 3.0%. Zone six (6) and seven (7) could be drill from one drill hole set up.

Anomalous zone #8

Anomalous zone #8, on line 0 between 5+90 N to 6+40 N, shows an higher F.E. of about 6.0% in a higher resistivity of about 15,000 to 30,000 Ohm-meters. Weak in response.

VII- CONCLUSIONS & RECOMMENDATIONS

The survey revealed eight (8) anomalous zones. Out of the eight (8) zones, six (6) zones of interest (good conductivity) should be tested by diamond drilling. The I.P. zones should be check if any mag anomalies coincide.

Sincerely yours,

REMY BELANGER
Geophysical contractor.
Figure 2: Claim map, Goodall Township; property as outlined (1 inch to ½ mile).
Magnetic Anomaly $0^00$ gamma

Shear

Au Value* of best Grab Samples

X 1980, 1981 (Minorex Ltd.)

1987 (Tasu Resources)

1988 (Black Cliff Mines Ltd.)

MAPPED BY:

DRAFTED BY:

DATE:

DECEMBER 1988

SCALE:

: 2500

PROJECT NO.:

MAP NO.:
RESISTIVITY (APP) IN OHM METER

FREQUENCY EFFECT (APP) IN %

METAL FACTOR (APP)

ELECTRODE CONFIGURATION

PHOTOGRAPH POINT X 25M

SURFACE PROJECTION

OF ANOMALOUS ZONES

NOTE CONTOURS AT LOGARITHMIC INTERVALS

DATE SURVEYED

OPERATOR

DATE;

INDUCED POLARIZATION AND RESISTIVITY SURVEY

COMPANY: BLACK CLIFF MINES LIMITED

PROPERTY: GOODALL

RED LAKE ONTARIO

LINE NO. 25E

ELECTRODE CONFIGURATION

PHOENIX IP-1

DATE SURVEYED

OPERATOR

DATE;

REMY BELANGER ENG.
RESISTIVITY (APR) IN OHM METER

FREQUENCY EFFECT (APR) IN 0X0

METAL FACTOR (APP)

COMPANY 1 BLACK CLIFF MINES LIMITED
PROPERTY: GOODALL
RED LAKE QUEBEC
LINE NO. 1
ELECTRODE CONFIGURATION

SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE
INSTRUMENT
CONTRACTOR
DATE SURVEYED

FREQUENCIES 25 A 40 Q

NOTE CONTOURS AT LOGARITHMIC INTERVALS

PHOENIX IPV-1
REMY BELANGER ENG.
APPROVED:
OPERATOR.
DATE

INDUCED POLARIZATION AND RESISTIVITY SURVEY
RESISTIVITY (APR) IN OHM METER

FREQUENCY EFFECT (APR) IN 70

METAL FACTOR (APP)

COMPANY 1 BLACK CLIFF MIMFS LIMITED
PROPERTY GOODALL
RED AKF ONTARIO LINE NO.

ELECTRODE CONFIGURATION
PLOTTING
POINT
SURFACE PROJECTION
OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

INSTRUMENT
CONTRACTOR
DATE SURVEYED

OPERATOR

FREQUENCIES

NOTE CONTOURS AT LOGARITHMIC INTERVALS

INDUCED POLARIZATION AND RESISTIVITY SURVEY
COMPANY: BLACK CLIFF MINES LIMITED

PROPERTY: GOODALL

RED LAKE - ONTARIO

LINE NO: F4

ELECTRICAL CONFIGURATION

PLOTTING POINT: 0.0 SGM

RESISTIVITY (APR) IN OHM METER

FREQUENCY EFFECT (APR) IN %

METAL FACTOR (APR)

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

INSTRUMENT

CONTRACTOR

DATE SURVEYED

FREQUENCIES: 25 A 4.0

NOTE CONTOURS AT LOGARITHMIC INTERVALS: 1.15, 2.0, 3.0, 5.0, 7.5, 10.0

PHOENIX IPV-I

REMY BELANGER ENRG.

APPROVED

OPERATOR

DATE: APR 22, 1952

INDUCED POLARIZATION AND RESISTIVITY SURVEY
RESISTIVITY (APR) IN OHM METER
N = 1
N = 2
N = 3
N = 4
N = 5

FREQUENCY EFFECT (APP) IN %
N = 1
N = 2
N = 3
N = 4
N = 5

METAL FACTOR (APP)
N = 1
N = 2
N = 3
N = 4
N = 5

COMPANY: BLACK CLIFF MINES LIMITED
PROPERTY: GOODALL
RED LAKE, ONTARIO
LINE NO. 9

ELECTRODE CONFIGURATION

PLOTTING:

SURFACE PROJECTION
OF ANOMALOUS ZONES
DEFINIT R
PROBABLE
POSSIBLE

NOTE: CONTOURS AT
LOGARITHMIC INTERVALS
1, 15, 2, 3, 5, 10, 20

INSTRUMENT
REMY BELANGER ENRG
APPROVED:

DATE SURVEYED
OPERATOR

INDUCED POLARIZATION AND RESISTIVITY SURVEY
09-88-17