SUMMARY OF GEOLOGY ON THE MINNOVA - KASHABOWIE PROJECT (PN677)

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Program Summary</td>
<td></td>
</tr>
<tr>
<td>LOCATION AND ACCESS</td>
<td>4</td>
</tr>
<tr>
<td>TOPOGRAPHY AND VEGETATION</td>
<td>4</td>
</tr>
<tr>
<td>PROPERTY STATUS</td>
<td>6</td>
</tr>
<tr>
<td>PREVIOUS WORK</td>
<td>8</td>
</tr>
<tr>
<td>GEOLOGY</td>
<td></td>
</tr>
<tr>
<td>Introduction</td>
<td>10</td>
</tr>
<tr>
<td>Stratigraphy</td>
<td>12</td>
</tr>
<tr>
<td>Structure</td>
<td>15</td>
</tr>
<tr>
<td>ALTERATION AND MINERALIZATION</td>
<td>16</td>
</tr>
<tr>
<td>CONCLUSIONS AND RECOMMENDITIONS</td>
<td>18</td>
</tr>
<tr>
<td>LIST OF REFERENCES</td>
<td>21</td>
</tr>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td></td>
</tr>
<tr>
<td>Figure 1 Location map</td>
<td>2</td>
</tr>
<tr>
<td>2 Grid location map</td>
<td>5</td>
</tr>
<tr>
<td>3 Claim map</td>
<td>7</td>
</tr>
<tr>
<td>4 Regional geology map</td>
<td>11</td>
</tr>
<tr>
<td>5 Generalized stratigraphic table</td>
<td>13</td>
</tr>
<tr>
<td>LIST OF MAPS</td>
<td></td>
</tr>
<tr>
<td>Geology Maps: East, Central, West sheets 1:5,000</td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCTION

The Kashabowie project, located west of Thunder Bay, Ontario (Figure 1) is a joint venture negotiated in November 1987 between Minnova Inc. and Deak Resources Corporation. The project includes the mineral rights of two key patent lots optioned from Greencoast Resources, and 245 unpatented claims. Previous operators have outlined approximately 300,000 tons of 1 to 2% copper in two separate occurrences on the patented claims. Little attention has been drawn to the fact that the showings also contain significant zinc, silver and gold. Mapping and sampling of the showings, the Vanguard East and West showings, by Minnova personnel has enabled definition of the exhalite, locally massive sulphide bearing Vanguard horizon. In the area of the showings the horizon has undergone strong deformation and some remobilization. Elsewhere on the property several areas of interest have been defined following field exploration programs in 1988 and 1989. Two diamond drilling programs were conducted during 1989 and 1990, having led to significant results, both in terms of mineralization and in understanding and interpretation of the geology and structure of the property.

Program Summary

Exploration activities conducted by Minnova Inc. on the Kashabowie project since work commenced in 1988, are summarized as follows:
- 670 line kilometers of airborne INPUT and magnetics were completed over the entire property in March, 1988.
- 157km of line cutting was completed in May, 1988.
- 157km of mapping at a scale of 1:2000 and sampling were completed in October, 1988, with a total of 2273 lithogeochemical samples and 100 geochemical samples having been collected.
FIGURE 1
LOCATION MAP

USA

MANITOBA

JAMES BAY

QUEBEC

KENORA

FORT FRANCES

KASHABOWIE PROJECT

GERALDTON

THUNDER BAY

SAULT STE. MARIE

SAULT ONTARIO

TORONTO

LEAKE HURON

LEAKE MICHIGAN

LEAKE ERIE

FIGURE 1
LOCATION MAP

100 MILES

100 KILOMETERS
- Stripping and washing of the Vanguard East and West showings, on patent claims K56 and 71Z, covering a total area of about 3.2 hectares was conducted. Both showings were mapped and sampled on a detailed scale of 1:100.
- 7.5km of IP were completed in October, 1988, covering the area including the Vanguard showings.
- 41km of DEEPEM were completed in December, 1988 with four loops, covering the Vanguard East and West showings and extending westward to cover a total strike length of approximately 3.5km.
- 3073 metres of diamond drilling was conducted from January to March, 1989.
- 22 line kilometres of Max Min EM was conducted on the ice in the region of the mouth of the Kashabowie River (the Thin Ice zone).
- 42 line kilometres of DEEPEM was conducted from January to March, 1989, in two areas of the property. The Thin Ice zone survey, near the mouth of the Kashabowie River comprised 30 kilometres, and the Whalen occurrence area comprised 12 kilometers.
- 35 kilometres of gridline cutting was completed on the Burstrom east grid. This grid extended eastward from the previously cut grid and extended to the eastern boundary of the claim group.
- 35 kilometres of the above mentioned grid was mapped and sampled during the summer, 1989. Other areas of the property, generally on the south side of Upper Shebandowan Lake were mapped and sampled in reconnaissance fashion, following claim lines at 400m intervals.
- Approximately 405 lithogeochem samples, and 70 geochem samples were collected and analyzed.
- 22 line kilometers of DEEPEM was conducted during September and October, 1989 on the Burstrom east grid, south of Three Mile Bay.
- 1795 metres of diamond drilling was conducted during March and April, 1990.
- 13 line kilometers of DEEPEM was completed on the Burstrom west grid area during March, 1990.

The results and interpretation of geological work are presented on the appended maps, and discussed in further detail below.

LOCATION AND ACCESS

The Kashabowie project area is located 115km northwest of Thunder Bay, Ontario, (Figure 1). The centre of the claim group lies immediately to the south of Kashabowie, a small town located on the CNR railway.

Access to the central and northeastern portion of the property is afforded by Hwy 11 where it crosses the property for approximately 7km, (figure 2). Further access can be obtained by the railway which lies along the northern border of the claim group, and by boat for areas covering the eastern end of Kashabowie Lake. Access to the western end of the property can be gained by boat along the shore of Upper Shebandowan Lake and by Hwy 802 south, an all weather logging road. The southeastern portion of the property, south of Three Mile Bay can be accessed by boat and by old logging and drill roads that cover the Burstrom grid area.

TOPOGRAPHY AND VEGETATION

The majority of the map area has moderate relief. On average the hills rise less than 50m above Upper Shebandowan Lake which is 450m above sea level. Outcrop exposure is relatively good except to the far west of the claim group where large swamps and deep overburden reduce outcrop
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KASHABOWIE PROJECT
GRID LOCATIONS

FIGURE 2
exposure, and west of the Kashabowie River where a thick glacial till occupies a paleovalley, burying bedrock to depths of up to 30m.

The metavolcanics on the property are exposed as elongate low ridges that lie parallel to the regional schistosity. Exposure orientation may be indicative of large scale faulting that is evident in the area. Gabbro is the most resistant rock unit of the area and forms most of the highest ridges on the property, particularly south of Upper Shebandowan Lake.

Some of the least resistant rock units of the property are well bedded, tuffaceous to argillitic sediments and tuffs which are recessive and form the topographic lows of Three Mile Bay and the overburden covered area which underlies the highway west of the Kashabowie River.

Mature mixed forest dominates the ridges and hills while cedar and balsam trees dominate the low swampy areas.

**PROPERTY STATUS**

The Kashabowie project area consists of 245 unpatented claims and 2 patented claims covering a land area of approximately 4,000 hectares (Figure 3).

The claims covering the Kashabowie property were not acquired as one single block but as a series of blocks optioned to Deak Resources and Minnova Inc. The blocks were staked over the period of January 1987 to September 1987 by two Thunder Bay prospectors, Dave Petrunka and Wayne McChristie. The claims cover portions of Haines township and Kashabowie, Greenwater and Burchell Lakes claim maps. Petrunka and McChristie pooled their claims and entered into an agreement with the aforementioned mining companies.

A joint venture negotiated in November 1987 between Minnova Inc. and Deak Resources Corporation could eventually result from the agreement between the three parties involved.
The final joint venture agreement will give Minnova Inc. a 60% interest and Wilco a 40% interest in the Kashabowie Property (See Northern Miner article appended).

Work filed for assessment has resulted in 100 man-days credit for 99% of the property. This credit will leave the entire claim block in good standing until early 1991.

PREVIOUS WORK

The Kashabowie area has received limited and sporadic exploration attention since the early 1870's. Most work on the volcanic belt has focused on epigenetic gold and copper deposits, the Huronian (Ardeen, Moss, Kerry) Mine and the North Coldstream (Tip Top) Copper Mine, and on nickel-copper mineralization associated with mafic to ultramafic intrusions and volcanics (Shebandowan Ni-Cu deposit).

Exploration activity that occurred within the project area led to the discovery of the East and West Vanguard showings, (fig. 2). Initially discovered in 1923 it was not until 1950 that Norpick Gold Mines tentatively delineated 150,000 tons grading 1.3% Copper, 0.02% oz/t Au and 0.25 oz/t Ag at the west Vanguard showing and 81,000 tons of 1.8% Copper, and 0.04 oz/t Au at the east Vanguard. It was not until 1954 that sphalerite was considered significant in the surface trenches and in drill core, (J.R. Bridges, Bandowan Mines Ltd., August, 1955). Approximately 7,600m of drilling in 1949/50 and early 1956 was undertaken in the area of the two showings to vertical depths not exceeding 200m. The latest work by Bandowan Mines implied that the host rock for mineralization was a cherty unit, and that mineralization was strongest when this unit was brecciated and/or close to an east-west striking shear zone (R. Laird, 1956, Bandowan Mines Ltd.) No later work has been reported for the area within the patent claims hosting the showings.
The Whalen showing area (fig. 2) was drill tested in 1956/57 by Upper Shebandowan Mines Ltd. Five drill holes totalling 515m intersected sericite and chlorite schists west and down dip of the surface trench. Chalcopyrite was reported in two holes but assay values were not noted. Upper Shebandowan Mines also drilled two holes in the Thin Ice zone (fig. 2) and intersected graphite to account for surface geophysical anomalies.

Shawmin Explorations Ltd. conducted geophysics, diamond drilling, and some geological work, prospecting and trenching, primarily on the peninsula which hosts the "Peninsula" Showing (fig. 2). Trenching and drilling on the Peninsula Showing (the N-20 zone, G.L. Holbrooke, 1967, Shawmin Explorations Ltd.) indicated fracture hosted chalcopyrite within anorthosite/gabbro. The average of eight intersections was 2.7% Cu along a length of 122m, and with an average core width of 1.3m. The zone was found to pinch out along strike to the south and to be cut by a splay fault related to the Crayfish Creek fault to the north. Shawmin drilled several other conductors mainly in the lake south of the peninsula with low grade intersections of copper and nickel in anorthosite/gabbro.

Falconbridge Nickel Mines Ltd. had options on the Shawman ground during the period from 1969 to 1974, and drilled five holes on the Whalen occurrence and an additional 15 holes totaling over 2,800m in the region south and west of the Whalen Showing.

Results of drilling on the Whalen occurrence are not available in government assessment files. Drill hole logs which are available indicate that the area south and west of the Whalen and Peninsula Showings is composed primarily of mafic intrusives, with one area of notable exception. Drilling in the area on the south shore of the lake southwest of Anderson Island intersected tuffs and interbedded cherts
and graphitic sediments. No mineralization was reported here but this stratigraphy has significant geological and structural implications.

Several other companies explored small claim blocks within the current property boundaries. Aldermac Copper Corp. explored the area of the Vanguard showings and westward in 1942 and 1943. They conducted magnetometer and self-potential surveys and drilled five holes in SP targets. Most of the geophysical anomalies tested were graphitic tuffs. Montco Copper Corporation conducted geophysics and diamond drilling in 1956 and 1957 southwest of the Vanguard West Showing. Drill logs describe altered mafic volcanics but only minor mineralization. Jellicoe Mines Limited also conducted work over areas of the southwest portion of Upper Shebandowan Lake and described the Copper Island occurrence. Drilling was conducted, and although drill hole locations are generally not provided in available logs, drilling was presumably concentrated on the Copper Island occurrence. Sparse chalcopyrite mineralization was reported in 8 or 9 drill holes. R. Oja also conducted geophysical work on the Copper Island area in 1971.

Noranda conducted geological work on several small claim blocks within the current property, as well as conducting an airborne survey in 1984.

**GEOLOGY**

**Introduction:**

The Kashabowie property is within the Wawa (Abitibi) granite-greenstone subprovince of the Canadian Shield and consists predominantly of a cyclical series of Keewatin (Neoarchean) volcanics and associated volcanioclastics, (fig. 4). The property straddles the Crayfish Creek fault, a major dextral fault zone, which extends from the Quetico fault near Crooked Pine Lake southeastward a distance of about 80km and
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KASHABOWIE PROJECT

GEOLOGY

Overburden
Granite
Gabbro
Anorthosite
Altered rhyolite breccia
Feldspar porphyry
Agglomerate, chert/frag. breccia
Acid volcanics
Basic volcanics
Intermediate volcanics, tuffs
Alteration

Property Boundary
Input Conductor Axis
eastward beyond the Inco Shebandowan Mine. The Postans fault, trending through the length of Kashabowie Lake marks the contact of volcanics to the south with Kashabowie group metasediments (J.M. Hodgkinson, 1968) to the north. The reader is referred to figure 4 and to the accompanying 1:5,000 geology maps appended to this report. Geology is presented on three maps, referred to as west, central and east sheets. The west sheet comprises geology on the West Grid, the central sheet, the Central Grid geology, and the east sheet comprises geology on the Mud Lake and Burstrom Grids, (fig. 2). An idealized stratigraphic column is presented in figure 5.

Stratigraphy:

Several features suggest that stratigraphy faces south. Hodgkinson (1968) notes graded beds indicating tops to south in the metasediments along the north shore of Kashabowie Lake. The felsic pyroclastic rocks which predominate in the northern portions of the property grade southward in a regional sense into their erosional products, the finer grained volcaniclastics which underlie Three Mile Bay. These tuffaceous sandstones and siltstones show graded bedding, also indicating south facing stratigraphy. Graphitic tuffs are interbedded with these volcaniclastics. This trend from felsic pyroclastic volcanism to a relatively quiescent period of clastic deposition marks the earliest cycle in the stratigraphy. The overlying cycle of volcanism is dominated by mafic flows, which vary texturally from massive, to amygdaloidal, pillowed and locally variolitic. These flows are increasingly interbedded with mafic tuffs and fragmental rocks toward the south. The Vanguard horizon, marked by chert, magnetite iron formation, iron carbonate sediment and, locally, massive sulphide, marks the transition from predominantly mafic flows, southward into predominantly mafic
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KASHABOWIE PROJECT
GENERALIZED STRATIGRAPHIC TABLE

WEST OF CRAYFISH CREEK FAULT

EAST OF CRAYFISH CREEK FAULT

UPPER SHEBANDOWAN LAKE

Mafic Tuffs

Mafic flows

VANGUARD HORIZON

'FOOTWALL' FELSIC TUFF

volcanopelites, graphitic sandstone, mafic & felsic tuffs

CRAYFISH CREEK FAULT

Mafic Tuffs

Mafic flows

VANGUARD HORIZON

cracks, hyaloclastite, ferroan, carbonate, and volcanic felsic flows

Mafic flows

volcanopelites, graphitic sandstone, mafic & felsic tuffs

Felsic coarse pyroclastics

Felsic ash tuffs

POSTANS FAULT

KASHABOWIE GROUP METASEDIMENTS

FIGURE 5
tuffs and fragmentals. A texturally distinct felsic lapilli tuff, occurs west of the Crayfish Creek fault, and is ubiquitously altered over a strike length of about 3km. This felsic unit thins westward from a thickness of approximately 100m in the area of the Vanguard showings to less than 10m in the southwestern portion of the property. The increased thickness and abrupt termination of this unit adjacent to the Crayfish Creek fault strongly suggests that this structure was active during the second cycle of volcanism.

Several thin exhalite horizons occur within the mafic volcanic sequence marking flow contacts. The Lone Hill occurrence is one such horizon associated with mafic flows and mafic fragmentals, (fig. 4).

The third cycle of volcanic activity, exposed east of the Crayfish Creek fault is initially marked by the deposition of siliceous fine grained ash and chert, overlain by fine to coarse mafic and felsic pyroclastic rocks. The Whalen showing occurs within this stratigraphy associated with a pillowed mafic flow. These volcanics occur at the top of the exposed stratigraphy on the property. Apart from minor bands of volcanic rock, the southern portion of the property, south of Upper Shebandowan Lake, is dominated by mafic intrusions.

Intrusive rocks on the property are dominantly gabbro and anorthosite. Granite intrusives, as narrow sills, dykes and small stocks are found throughout the property. A distinctive sub volcanic, feldspar porphyritic intrusion occurs on the Mud Lake grid, and contains rafts of felsic, coarse pyroclastic rock near its top.

More detailed descriptions of rock units on the property are included in Appendix I.
Structure:

Most of the volcanic rocks of the Kashabowie property show some degree of deformation, generally a stratigraphically sub parallel foliation, which trends northeast on the West and Central grids west of the Crayfish Creek fault, and east northeast in areas east of the fault. The orientation of rock exposures generally reflects this trend. The foliation varies in intensity and where most intense is assumed to represent ductile shear zones. A detailed analysis of this phase of deformation was not systematically conducted over the entire property however several strongly foliated zones were noted. The most significant zone occurs generally following the Vanguard horizon and is readily visible as a strong pervasive foliation in the rock exposures on the Vanguard East and West showings. In these areas the fabric trends at approximately 70° and dips steeply south. Lineations on the plane of the foliation, including intersection lineations and those defined by the elongation of varioles, dip westward at about 70°.

Another strongly foliated zone occurs across a width of 100 to 200m generally following the northwest shore of Upper Shebandowan Lake to the Crayfish Creek fault. Similarly, strong foliations are observed in several exposures west of the Crayfish Creek fault adjacent to the main highway.

East of the Crayfish Creek fault strongly foliated, continuous zones trend along the south shore of Three Mile Bay, and on the Burstrom grid area in several areas, particularly in the upper felsic pyroclastic cycle.

This early ductile fabric is postdated by a more brittle deformation related to the Crayfish Creek fault. This system includes the Crayfish Creek fault which has a dextral offset of about 1.7km, with a steep to moderate southwest dip. The fault is generally a system of anastomozing faults observed
over a width of about 350m. A related composite set of sinistral faults are also observed, particularly east of the Crayfish Creek fault. These faults are generally narrow structures with displacements of less than 700m.

ALTERATION AND MINERALIZATION

Alteration related to synvolcanic hydrothermal activity is difficult to recognize in the field because of subsequent deformation and later hydrothermal activity. Visually the alteration is recognized by the occurrence of light to medium green coloured chlorite in the felsic rocks and by darker green chlorite in mafics, however this chlorite is not readily discernable from the more widespread chlorite associated with strongly foliated zones.

Iron carbonate is a significant alteration product associated with the discrete shear zones discussed above. These iron carbonate hosting shears are particularly evident in the area of TL10S on the Burstrom grid. Iron carbonate is also prominent at the Vanguard East and West Showings.

Mineralization which initiated Minnova’s interest in the Kashabowie property occurs as massive sulphide lenses in the Vanguard East and West showings. During 1988 these showings were cleared, mapped and sampled in detail to delineate the stratigraphy and structure and to determine the origin of the massive sulphide.

The Vanguard East showing occurs within a highly deformed sequence of altered, variolitic and amygdaloidal mafic flows. Mineralization consists of a 1 to 4 meter wide lense, about 20m in strike length consisting of massive sulphide grading laterally into cherty exhalites and minor magnetite iron formation. A maroon coloured iron carbonate metasediment is also associated. Silicification is locally evident and the volcanics both north and south of the sulphide horizon are strongly depleted in Na₂O.
Mineralization at the showing consists of sphalerite, chalcopyrite, magnetite and pyrite. Sphalerite appears to be spatially associated with magnetite and occurs in greater concentrations in the lower 0.5-1.0m portion of the zone. Chalcopyrite and pyrite are more closely associated, occurring in the upper portions of the massive sulphide and hosting local concentrations of Ag and Au.

The Vanguard West showing occurs approximately 900 meters west of the East Showing, separated by gabbro and anorthosite and occurring adjacent to a splay fault associated with the Crayfish Creek fault. The west showing is similar in stratigraphy and structure to the east but consists also of a larger area of silicification with stringer style pyrite and chalcopyrite mineralization. Bedded massive sulphide occurs over a strike length of approximately 15 meters, cut off to the west by faulting and grading to the east into the silicified rock with stringer pyrite and chalcopyrite.

Westward along strike from the Vanguard West showing, the Vanguard horizon is poorly exposed, however pyritized fragmental to breccia-like rocks associated with the Vanguard stratigraphy are observed. Fragments within this unit include chert-magnetite iron formation and iron carbonate metasediment.

Other showings on the property include the Harkness showing, the Peninsula Showing and the Copper Island occurrence. The Whalen occurrence lies on Crown land, not open for staking, within the property and has not been thoroughly investigated.

The Harkness showing consists of a deep pit which exposes a 0.5m wide silicified, to quartz veined zone containing 15 to 30% pyrite hosted in chloritic, ferroan carbonate altered mafic volcanics. A small exposure of carbonate metasediment similar to that of the Vanguard
showing occurs nearby. Two composite chip samples from the 0.5m zone gave average values of 1250ppm Cu, 2469 ppm Zn, and 1393ppb Au.

The Peninsula showing contains fracture controlled chalcopyrite hosted in a diorite-anorthosite-gabbro complex. Drilling in the mid 1960's consisted of 11 holes with maximum vertical depths of 60 meters. Mineralization was sporadic, with the most favorable intersection grading 3% Cu over 2.9 meters. During the 1989 field season the old trenches were cleaned and sampled. Chalcopyrite mineralization occurs in a set of conjugate fractures trending generally at 10-20° and 110-120°. Mineralization is discontinuous along the fractures, but may occur as lenses or pods up to 0.5m wide, and consists of massive chalcopyrite with coarse to fine grained amphibole and minor quartz veining. Alteration associated with the mineralization is not readily evident in the host anorthosite-gabbro. Silicification is only locally evident.

The Copper Island occurrence has not as yet been thoroughly investigated. Previous work indicates that copper mineralization occurs in northeast striking shears within chloritized diorite, as irregular lenses, veins and disseminated chalcopyrite, with minor pyrite and galena.

On the Burstrom grid (East geology sheet) the Vanguard horizon generally marks the transition from predominantly mafic flows toward the north, to mafic tuffs toward the south. Grab samples from cherts and magnetite iron formation along the horizon yield anomalous copper and zinc values in the range of 200 to 541ppm Cu, and 200 to 1760ppm Zn.

CONCLUSIONS AND RECOMMENDATIONS

The primary target on the Kashabowie property is the Vanguard horizon which extends over a strike length of approximately eight kilometers. Drilling to date has
concentrated primarily on a small portion of the horizon in the area of the Vanguard East and West showings where mineralization and alteration are best exposed. Our work to date in this area shows that massive sulphide deposition does occur but that it's continuity may be masked by later remobilization and structural discontinuities. The most encouraging feature, apart from the local occurrence of massive sulphides with copper, zinc and associated precious metals, is the footwall alteration indicative of a hydrothermal system. This system continues westward from the showing areas for a minimum distance of one kilometer. The Vanguard horizon although not entirely exposed does continue westward as well, based on stratigraphic relationships and IP anomalies.

On the east side of the Crayfish Creek fault, on the Burstrom grid the Vanguard horizon stratigraphy contains exhalites, hyaloclastites, ferroan carbonate metasediment, and magnetite iron formation with anomalous copper and zinc values over a strike length of 3 kilometres. DEEPEM surveys have been conducted over this region without detecting strong conductivity. Alteration in footwall rocks is not extensive in the Burstrom grid area except in footwall rocks 100 to 200m stratigraphy below the Vanguard horizon and locally adjacent to the horizon, however metal values along the horizon are elevated above statistically significant levels. This suggests that the surface exposures mark the fingers of the system which could be buried at depths below 250 to 300m. Further prospecting is necessary in conjunction with IP surveys to assist in targeting future drilling along this extensive horizon.

Another first order target that requires further investigation is the area east of the Whalen occurrence. At the Whalen occurrence a strong schistosity precludes a definitive determination of the nature of the pyrite,
chalcopyrite mineralization, however the sulphides are, for the most part disseminated and most likely represent stringer mineralization. Accompanied with the alteration which occupies a significantly large area, and the coarse pyroclastic characteristics of the volcanics, the area east of the Whalen offers good potential.

Further geological work should include more detailed prospecting of the areas discussed above and evaluation of other areas in the southern portions of the property. The work conducted on the Kashabowie project to date has provided a good understanding of the stratigraphy and mineralization of the property, and presented interesting challenges toward the discovery of more significant mineralization.
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APPENDIX I

ROCK UNIT DESCRIPTIONS

VOLCANICS:
Mafic flows (Ma)

Mafic flows are widespread on the Kashabowie property. They are commonly massive and weakly to moderately foliated. Quartz and/or Fe-carbonate filled amygdules are often the only indicator of the flow nature at the mafic volcanics. Well developed pillows are only locally preserved and the best exposures are located on line 31E at 20+50N. There the pillows range in size from 0.50cm to 1.5m long and are elongated subparallel to the regional schistosity. Stretching of pillows make top determination ambiguous, however a good exposure of pillows occurs on the Burstrom grid on line 90E, 40m north of the baseline. This exposure clearly indicates tops to the south. The northern limits of the property are underlain by a series of mafic flows that are locally pillowed just south of the town of Kashabowie. The pillows exhibited in this unit have been stretched along the plane of deformation and offer ambiguous top directions. This unit is laterally extensive to the east and is truncated against the Crayfish Creek fault to the west. Well preserved variolitic pillows occur on the island at the mouth of the Kashabowie River, and variolitic flows are also evident at the Vanguard East showing and in the mafic rocks at the west end of the Burstrom grid. Whether these variolitic rocks are confined to a single stratigraphic unit is an important consideration and a question which is as yet unresolved.

Occasional hyaloclastites are observed, the best exposure of which is found on the Burstrom grid at line 89 +
70E just along the south side of the logging road. Overall the mafic flows have low SiO₂ content < 52% associated with high TiO₂ content > .80 commonly between 1.4-1.9%.

**Mafic tuff (Mt, Mtbx)**

Various pyroclastic "flows" occur intercalated with the mafic flows. The coarser units contain various amounts of polymictic fragments. Felsic and/or pumice fragments are common. The chloritic mafic fragments are often ill defined and/or totally obscured by a pervasive moderate to strong foliation. Along the west shore of Upper Shebandowan Lake pyroclastics occur as alternating felsic and mafic lithologies. Contacts are generally sharp between flows which contain 30-40% fragments and which are generally less than a meter in thickness. Fragments are lapilli to bomb size, mainly siliceous, and elongate parallel to foliation, occurring in a vesicular mafic matrix.

Finer grained pyroclastics are also evident and sometimes difficult to distinguish from flows. They are generally gritty textured, homogeneous and massive but with occasional coarser fragments. Excellent examples of these fine grained mafic tuffs are exposed on the Burstrom grid in the area of line 94E at 1+80N. The mafic unit extending along the north shore of Three Mile Bay is in part pyroclastic.

Chert and iron formation are commonly present in minor amounts. The most extensive chert rich pyroclastic lense is exposed along strike from L3W at 7+50N to L3E at 7+50N (Mtbx unit). It is composed of up to 40% unsorted mixed fragments (10% or more of which are cherty frags) in a strongly carbonate rich chloritic matrix. Cherty fragments are larger and a breccia texture is well developed on the western extent of the unit.
Mafic flows and tuffs are the dominant rock type in cycle 2 volcanism, and comprise approximately 30-40% of cycle 3 volcanism.

**Felsic units (Ft, Fxt, Flxt)**

Overlying the basal mafic unit on the northern limits of the property is a felsic unit composed of a lower felsic flow member which contains lenses of quartz crystal tuff and of an upper mixed fragmental member.

The flow member (Ft) is often creamy white - to pinkish, massive often more jointed than foliated and does not contain abundant quartz phenocrysts. It is best exposed under the power line in the northwestern portion of the property and along Hwy 11 on lines 89E and 90E. Locally, flow banding is exhibited, but primary textures are commonly obscured or transposed along a moderate semi-penetrative 70-90° foliation.

Intercolated within this felsic flow unit is a distinct crystal tuff, (Fxt). The crystal tuff is fine grained, contains up to 8% small (< 2mm) sub-rounded feldspar and quartz phenocrystals in a dark purplish siliceous matrix. Definite fragments are rarely seen in this tuff.

The crystal tuff is well exposed in 3 main areas:

1) Under the power line on claim K56, west of Kashabowie road where discontinuous lenses (up to 300m long x 50m wide) are contained within the lower felsic unit.

2) As a long wedge north-northwest of Mud Lake where it sits between the basal mafic unit and the lower felsic unit.

3) Along the south shore of Kashabowie Lake northeast of Mud Lake.
The upper fragmental member of this lowermost felsic unit is extensive and well exposed extending from under the power line west of Kashabowie road well into the Mud Lake Grid. It is composed of stretched to occasional sub-rounded unsorted mixed fragments (up to 45% ranging in size from 5cm up to 40cm) in a siliceous often sericitic matrix. The nature and abundance of fragments is quite variable throughout the unit. Mostly monolithic in its lower part, the unit is composed of > 95% felsic fragments and approximately 5% smaller cherty and chloritic fragments, in a creamy-white siliceous aphanitic matrix.

The upper part of the unit (exposed mainly along Hwy 17 between lines 50E and 80E) is heterolithic and contains up to 15% mixed fragments including: chert and jasperoid, massive magnetite, massive pyrite, and fragments of cherty iron formation. The heterolithic part of the mixed fragmental member has never been found in place on the grid, but occurs as xenoliths at the top of the feldspar porphyry. Often sheared, the matrix of these xenoliths is commonly moderately to strongly sericitic.

Another pyroclastic crystal tuff extends mainly southward and eastward from the subvolcanic feldspar porphyry. It is also locally present north of the feldspar porphyry, (L61E-L65E). The pyroclastic crystal tuff contains 40 to 65% often broken creamy-white feldspar crystals ranging in size from 2 to 5mm. Clasts composed of crystal tuff are found in a feldspar crystal rich matrix. The clasts are generally ill defined due to the pervasive, locally strongly developed foliation. The best exposure of well preserved undeformed pyroclastic fragments is located on L63E at approximately 1500N. The fragments range between 3cm up to 50cm and appear to be graded with apparent decrease in size southward.
In the upper portions of the stratigraphy on the Mud Lake Grid the felsic volcanics are more quartz rich. Quartz phenocrysts occur in both massive flows and in lapilli tuff. Massive flows with well preserved flow banding are exposed on line 59E at 1050N. Massive flows in this unit are usually thin and intercolated with lapilli tuff composed mainly of felsic lapilli ranging in size from 3cm to 5-8cm. Locally and more commonly near shear zones the matrix has a pinkish tinge due to faint diffuse hematite.

Near the Crayfish Creek fault the lapilli are smaller in size averaging 3 to 5cm. On Line 42E at 10+20N and under the power line between line 80E-86E the lapilli and/or fragments are larger (up to 10cm) but also more stretched due to local shearing.

Several thin fine grained felsic tuffs occur within the predominantly volcaniclastic unit which generally underlies Three Mile Bay. These are generally not exposed on surface but have been intersected in drilling. These tuffs and volcaniclastics mark the top of cycle 1 volcanism.

A unique felsic tuff occurs below (north of) the Vanguard horizon on the patent claims K56 and 71Z and extends southwestward for a kilometer or more. The unit is about 80 metres thick on the patents but thins to the west to less than 10 metres. It does not appear to extend eastward beyond the Crayfish Creek fault. Texturally, the unit is a pale white to grey, "pitted and poxed" weathering tuff characterized by 30 to 70% rounded to subangular lapilli or (spherulites?) up to 3mm in diameter. The lapilli often resemble feldspar phenocrysts when subangular but have grey-white siliceous cores with white quartz sericite rims. Less abundant fragments up to 2cm in diameter occur, with siliceous rims and inner cavities partially filled with druzy
quartz. These lapilli and pumaceous fragments commonly occur in a chlorite sericite matrix. The unit is informally termed the tapioca felsic tuff.

Apart from several thin felsic tuffs the tapioca felsic tuff appears to be the only significant felsic unit in the predominantly mafic volcanism marking cycle 2.

The felsic volcanics marking the third cycle of volcanic activity are comprised of an early distal siliceous bedded ash, with some quartz-eye rhyolitic tuffs or flows, cherty laminations and thin beds, and mauve coloured laminated to bedded volcanioclastics. This unit is generally moderately to strongly foliated throughout and suggests that banding in some instances is the result of deformation. Typical exposures of this unit are best observed at the shoreline on the south end of lines 62E and 63E and in the area of L94E at 5+00S, near the property boundary.

Coarser pyroclastics overlying the felsic ash tuffs consist mainly of felsic lapilli to bomb size fragments with thin fine ash layers between pyroclastic flows. These units are separated by coarse mafic pyroclastics in the areas north and east of the Whalen occurrence.

**INTRUSIVES:**

**Feldspar Porphyry**

A distinctive, green coloured, medium to coarsely porphyritic subvolcanic intrusion occupies the central portion of the Mud Lake grid. Phenocrysts are typically feldspar averaging about 2-3mm in diameter and comprising from 40 to 70% of the unit in a mafic, weakly to moderately chloritic matrix. Occasionally, fine quartz phenocrysts are observed. Upper portions of the porphyry contain rafts of coarse felsic pyroclastics, and the best exposures of the unit are along Highway 11 just east of the Kashabowie River.
TiO₂ content is in the order of 0.75% to 0.85%, with SiO₂ values of 56 to 60%, and Na₂O relatively high, averaging 3.5 to 4.0%.

Gabbro

This unit is generally massive, medium to fine grained equigranular to locally porphyritic plagioclase and amphibole +/- pyroxene gabbro. The gabbro is often chloritic, weakly to strongly magnetic and occasionally calcitic. The equigranular texture associated with the lack of definite volcanic texture was used in the field to differentiate fine grained gabbroic intrusive from mafic flows. Locally the gabbro can be seen to grade into diorite.

Geochemically the intrusive gabbro has a similar SiO₂ content to the mafic volcanics. The TiO₂ content is lower in the gabbro, averaging 0.55% TiO₂ compared to generally above 1.0% for mafic flows. This may reflect a genetic relationship between the gabbros, diorites and anorthosite.

Gabbro intrusives and sills are widespread throughout the property and are commonly elongated subparallel to the regional foliation.

Anorthosite

The anorthosite is creamy white composed of up to 85% coarse grained plagioclase feldspar (up to 1.5cm dia.) and with 15% chloritized amphibole interstitial to the feldspar phenocrysts. Commonly the feldspar is altered to a whitish clay-like mineral.

Geochemically the anorthosite is characterized by low SiO₂ approximately 48-50% associated with low TiO₂ values of 0.25%. Erratic fine chalcopyrite seams and malachite stains occur locally in the anorthosite.

The anorthosite is associated spatially with a siliceous chloritic breccia (Scbx) which is exposed between lines 38E
and 39E on patent claim 71Z. This unit is heterogeneous with diffuse and irregular contacts between coarse grained siliceous and fine grained chloritic rich phases. Magnetite knots, greatly variable in size occur erratically scattered in this zone. "Pseudo-spherulite" rich zones are locally well developed. The nature and relationship of this altered and heterogeneous zone with the anorthosite is still unclear.

**Syenite-monzonite-granite (Gr)**

Equigranular fine to medium grained, generally pinkish red syenite to monzonite to granite felsic intrusives occur within the map area. Small-stocks and/or sills occur mainly eastward from the Crayfish fault in the Mud Lake grid. These intrusives are composed of potassic feldspar and amphibole +/- quartz. Magnetite is often found as disseminated grains and in fractures, but also as sweats in surrounding rocks.

**Porphyritic dykes (Gr)**

Quartz and quartz and feldspar porphyritic dykes are common throughout the area. They are mostly elongated parallel to the regional foliation. These dykes are generally aphanitic to fine grained and non-porphyritic when less than a few metres in width.
Wilco and Minnova Inc. pool Shebandowan claims

Wilco Mining of Toronto and Minnova Inc. say they plan to pool properties held by both companies under option agreements with prospectors David Petrunka and Wayne McChristie.

Under a joint venture agreement, when the partners spend $1.25 million on exploration Minnova (as operator) will earn a 60% working interest in the claim group while Wilco retains 40%.

Located 60 miles west of Thunder Bay, Ont., near Upper Shebandowan Lake, the combined properties add up to about 10,000 acres and are comprised of 243 unpatented claims.

Residual interests in the two mining locations (measuring 397 acres), containing the Vanguard copper prospect, were bought by Wilco from Montreal-based Green Coast Resources.

According to Wilco President Douglas Hume, the mining locations were originally held under option by the prospectors who had assigned their working interest to Wilco.

He says consideration for the option is an initial cash payment plus 100,000 treasury shares of Wilco. Exploration programs may be accelerated or staged at an annual rate of $250,000 in exploration work and a cash payment to the prospectors as well as payment of 50,000 treasury shares of Wilco.

At the option of both Wilco and Minnova, at any time within the 5-year option period, they may purchase the prospectors' entire interest in the claim group by payment of an aggregate of 250,000 treasury shares of Wilco and $150,000 in cash.

Hume says $1 million in exploration and development work must also be completed. The vendors retain a 2% net smelter royalty, subject to a partial buy-back provision.

The Vanguard prospect was explored for copper in the 1940s and 1950s. Mineralization occurs, according to Wilco, in a chart horizon that has been traced for about 4,000 ft.

Past drilling produced unusually high gold assays in a hard glassy mineral called chert, providing the impetus for re-examination of the property.

Recent sampling of old showings has produced high values in copper/zinc and silver together with significant gold.

Minnova and Wilco geologists view the sulphide zones in the chert as volcanogenic and will explore the Vanguard prospect for polymetallic massive sulphides.

Hume says a number of other sulphide and gold showings occur within the 10,000-acre claim group. Exploration work is expected to get under way with a few weeks, he says.
July 27, 1990

Mining Recorder
Ministry of Northern Development and Mines
435 James Street South
P.O. Box 5000
THUNDER BAY, Ontario
P7C 5G6

Dear Sir:


The assessment work credits, as listed with the above mentioned Notice of Intent have been approved as of the above date.

Please inform the recorded holder of these mining claims and so indicate on your records.

Yours sincerely

W. R. Cowan
Provincial Manager, Mining Lands
Minerals and Minerals Division

DM/dvl
Enclosure

cc: Mr. W. D. Tieman
Mining and Lands Commissioner
Toronto, Ontario

Minnova Inc.
Toronto, Ontario

Resident Geologist
Thunder Bay, Ontario

Mike Flanagan
Thunder Bay, Ontario
<table>
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<th>Mining Claims Assessed</th>
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**Section 77 (19)** See "Mining Claims Assessed" column

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Special credits under section 77 (16) for the following mining claims

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No credits have been allowed for the following mining claims

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**Special credits under section 77 (16) for the following mining claims**

- 30 days Geological
- 20 days Geological
- 10 days Geological

**No credits have been allowed for the following mining claims**

- TB 964370

The Mining Recorder may reduce the above credits if necessary in order that the total number of approved assessment days recorded on each claim does not exceed the maximum allowed as follows: Geophysical - 80; Geological - 40; Geochemical - 40; Section 77(19) - 60.
### GEOLOGICAL

**MINING LANDS SECTION**

**Claim Holder(s):** MINNOVA INC.
**Address:** Suite 3970, Commerce Court W., Toronto, Ontario M5L 1C7
**Prospector's Licence No.:** T-556

**Township or Area:** KASHABOWIE AREA
**Prospector's Licence No.:** 2.13361

**Survey Company:** MINNOVA INC.
**Name and Address of Author of Geo-Technical report:** Mike Flanagan, 2606 Victoria Ave., E., Thunder Bay, Ontario P7C 1E7

**Survey Period:**
- **Day:** 01
- **Month:** 05
- **Year:** 88
- **Day:** 11
- **Month:** 89
- **Year:** 705 km

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**Geophysical Expenditures**

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**Geological Expenditures**

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<td>and end cutting</td>
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**Explores (excludes power stripping)**

**Use of Work Performed**

**Note:** Special provisions (not applicable to airborne surveys)

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**Credits Requested per Each Claim in Columns at Right**

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**Total Credits**

- **Days Credits:** 105

---

**Verification of Expenditure Days Credits**

**Date Certified:**
- **Date:** June 8, 1990
- **Name and Address of Person Certifying:** Mike Flanagan, 2606 Victoria Ave., E., Thunder Bay, Ontario P7C 1E7

---

**Date Certified:**
- **Date:** June 8, 1990
- **Signature:** [Signature]
Type of Survey(s) — GEOLOGICAL

Township or Area — KASHINABOWIE / UPPER SHEBANDOWAN

Claim Holder(s) — MINNOVA INC

Survey Company — MINNOVA INC

Author of Report — MIKE FANNAGAN

Address of Author — 2606 VICTORIA AVE. E., THUNDER BAY

Covering Dates of Survey — MAY 1983 to NOVEMBER 1987

Total Miles of Line Cut — 192 KM

SPECIAL PROVISIONS CREDITS REQUESTED

Geophysical

ENTER 40 days (includes line cutting) for first survey.

ENTER 20 days for each additional survey using same grid.

Geological — 40

Other

MAGNETOMETER

RADIOMETRIC

AIRBORNE CREDITS

Magnetometer — ELECTROMAGNETIC — RADIOMETRIC

(enter days per claim)

DATE: June 8, 1990

SIGNATURE: Author of Report or Agent

Res. Geol. — Qualifications — 2.7911

Previous Surveys

File No. — Type — Date — Claim Holder

TOTAL CLAIMS — 125
**GEOPHYSICAL TECHNICAL DATA**

**GROUND SURVEYS** – If more than one survey, specify data for each type of survey

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**Diurnal correction method**

**Base Station check-in interval (hours)**

**Base Station location and value**

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**MAGNETIC**

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**Diurnal correction method**

**Base Station check-in interval (hours)**

**Base Station location and value**

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**ELECTROMAGNETIC**

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**Accuracy**

**Method:**

- Fixed transmitter
- Shoot back
- In line
- Parallel line

**Frequency**

(specify V.I.F. station)

**Parameters measured**

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**GRAVITY**

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**Base station value and location**

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**Elevation accuracy**

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**INDUCED POLARIZATION**

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**Parameters**

- On time
- Off time
- Delay time
- Integration time

**Frequency**

**Range**

**Power**

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<tr>
<td>Instrument(s)</td>
</tr>
<tr>
<td>(specify for each type of survey)</td>
</tr>
<tr>
<td>Accuracy</td>
</tr>
<tr>
<td>(specify for each type of survey)</td>
</tr>
<tr>
<td>Aircraft used</td>
</tr>
<tr>
<td>Sensor altitude</td>
</tr>
<tr>
<td>Navigation and flight path recovery method</td>
</tr>
<tr>
<td>Aircraft altitude</td>
</tr>
<tr>
<td>Line Spacing</td>
</tr>
<tr>
<td>Miles flown over total area</td>
</tr>
<tr>
<td>Over claims only</td>
</tr>
</tbody>
</table>
GEOCHEMICAL SURVEY – PROCEDURE RECORD

Numbers of claims from which samples taken

<table>
<thead>
<tr>
<th>Total Number of Samples</th>
<th>Type of Sample</th>
<th>Average Sample Weight</th>
<th>Method of Collection</th>
<th>Soil Horizon Sampled</th>
<th>Horizon Development</th>
<th>Sample Depth</th>
<th>Terrain</th>
<th>Drainage Development</th>
<th>Estimated Range of Overburden Thickness</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SAMPLE PREPARATION</th>
<th>(Includes drying, screening, crushing, ashing)</th>
<th>Mesh size of fraction used for analysis</th>
</tr>
</thead>
</table>

| GENERAL | |
|---------| |

<table>
<thead>
<tr>
<th>ANALYTICAL METHODS</th>
<th>Values expressed in:</th>
<th>per cent</th>
<th>p. p. m.</th>
<th>p. p. b.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu, Pb, Zn, Ni, Co, Ag, Mo, As, (circle)</td>
<td>Others</td>
<td>Field Analysis (tests)</td>
<td>Extraction Method</td>
<td>Analytical Method</td>
</tr>
<tr>
<td>Field Laboratory Analysis</td>
<td>No. (tests)</td>
<td>Extraction Method</td>
<td>Analytical Method</td>
<td>Reagents Used</td>
</tr>
<tr>
<td>Commercial Laboratory (tests)</td>
<td>Name of Laboratory</td>
<td>Extraction Method</td>
<td>Analytical Method</td>
<td>Reagents Used</td>
</tr>
</tbody>
</table>

| GENERAL | |
|---------| |
KASHABOWIE PROJECT

LEGEND

ROCK TYPES
- Mafic flows
- Mafic pyroclastic flow / breccia
- Mafic pyroclastic flow / breccia
- Felsic pyroclastic flow
- Basalt - felsic dykes
- Gabbro
- Anorthosite
- Feldspar porphyry
- Alteration

SYMBOLS
- Geology
- Topography
- Geophysics
- Outcrop outline
- Foliation - vertical, inclined
- Bedding — horizontal, inclined
- Jointing - vertical, inclined
- Fault
- Swamp
- DEEPM response — channels
- IP chargeability
- Sulphide vol., grain size (Hg, s)
- Geological Contacts

Abbreviations
- cC — carbonate
- cNorit — norite
- hematite
- chalcopyrite
- magnetite
- pyrrhotite
- mpeg — mafic pyroxene
- msi — mica-silicate
- frag — fragments
- pyrite
- sericite
- siliceous
- amphibolite
- brecciated

TERRAIN
- Fine grained granite
- Medium grained granite
- Massive mafic dyke
- Sediment
- Vesicular asphalt

POWER TRANSMISSION LINE
- Roads — gravel, highway
- Hydro line
- Claim post — located, inferred
- DDH - 1989 drilling
KASHABOWIE PROJECT

GEOLOGY:

REVISIONS:

1.13361

KASHABOWIE LAKE

HARKNESS

OCCURRED

jfl.r .--

LEGEND

SYMBOLS

Geology

UPPER SHEBANDOWAN L

ACE MCM

FALCON

Geology

Felsic pyroclastic

Felsic quartz—feldspar crystal tuff

Felsic lapilli—crystal tuff

Siliceous chloritic breccia

Granite - QP dykes

Gabbro

Anorthosite

Feldspar porphyry

ALTERATION ( O.OOJC Na 20

Topography

Geophysics

Outcrop outline

Foliation — vertical, inclined

Bedding - vertical, inclined

Jointing — vertical, inclined

Pillow

Fault

Swamp

OEEPEM

Response - channels

MAXMIN

Response

transmission line

Roads - grovel, highway

Hydro line

Claim post - found, inferred

OQH collar - located.

OQH - 1989 drifting

Geological Contacts

— — — — — — — —

Observed

— — — — — — — —

Interpreted

Abbreviations

carb carbonate

cbl chlorite

tlen nielite

cp chalcopyrite

mag magnetite

pa pyrrhotite

siliceous

tot 

flare associated

sii

siliceous

frag 

cco

sericite

pyrite