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GEOPHYSICAL REPORT

On The
Gravity Survey
of the

ATAN LAKE BARITE OCCURRENCE

of

TOURNIGAN MINING EXPLORATIONS LTD.

AUGUST, ADAIR, SKI, WOLF and ATAN MINERAL CLAIMS

Situated

Immediately east of the Abandoned Settlement

of

MCDAME POST

Cassiar District

LIARD MINING DIVISION

Latitude 59°12'N: Longitude 129°15'W

N.T.S. 104P/3

Field work March 3 to 13 and May 14 to June 14, 1973.

July 16, 1973.
Delta, B.C.

Report by:
D.R. COCHRANE, P.Eng.



Cochrane Consultants Limited
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PART A

A-1 PREAMBLE:

During the period March 3rd to 13th, 1973 the author and Mr. A. Scott completed some 5 line miles and recorded 178 gravity observations on the ice of Atan Lake near McDame Post in Northern British Columbia. During the period May 14 to June 14, 1973 the author and a field crew employed by Cochrane Consultants completed 22 line miles of gravity and transit surveying and established and recorded 712 gravity stations in the area around Atan Lake. The work was completed on behalf of Tournigan Mining Explorations Ltd., Suite 704 - 535 Thurlow Street, Vancouver, B.C. A Scintrex CG-2 gravimeter (serial #196) was utilized for geophysical surveying, and a K & E transit and Nikon level for conventional surveying.

The purpose of the work was to outline, if possible, areas of anomalously high gravity response since several barite zones are known to exist on the property and since overburden covers the vast majority of bedrock exposure.

This report describes the setting; field and data processing methods and discusses the results obtained.

A-2 SUMMARY AND CONCLUSIONS

1. Tournigan Mining Explorations Ltd. of Vancouver, British Columbia, owns outright some 43 contiguous, located mineral claims, and three fractional claims situated in and around Atan Lake near McDame Post in the Liard Mining Division of British Columbia.
2. Facile access to the property is provided by a jeep road proceeding south from near Good Hope Lake on the Watson Lake - Cassiar Highway to McDame Post on the Dease River. Tournigan Mining has constructed a network of roads from McDame to various points on the property. Fixed wing and helicopter service is also available in Watson Lake and both Atan Lake and the Dease River are large enough to accommodate float equipped aircraft.
3. The British Columbia Railway owns a surface right of way strip across the Atan Lake property for rail extension from Dease Lake to Lower Post. The rail extension north to Dease Lake is now under construction. The claims lie in gently rolling country within the Dease Valley and there is an abundance of water and timber in the area.

4. Exploration work on the property by Tournigan Mining commenced in 1967, and to date work has included the following:

- (a) induced polarization surveying
 - (b) magnetometer surveying
 - (c) limited diamond drilling
 - (d) bulldozer trenching and road building
 - (e) a geochemical soil sampling survey
 - (f) geological mapping
- and (g) a gravity test survey.

The above described exploration work was carried out on restricted areas of the claim group, and was somewhat hampered by the lack of bedrock exposure and the presence of widespread, and in certain areas an extremely thick sequence of sand and gravel overburden.

5. Several induced polarization anomalies remain unexplained, but are possibly due to the presence of sulphides. Bulldozer trenching has exposed pods, lenses and veins of massive barite accompanied by knots of galena and finely disseminated tetrahedrite. The centers of the lenses are essentially pure, coarse crystalline, barite. Two barites zones have been discovered to date and are designated the North zone, and Barite Hill zone.

6. Previous gravimetric geophysical surveying indicated the presence of several million tons of excess mass, however the coverage was restricted in areal extent. The 1973 work, described herein, consists of some 22 miles of gravity work, including establishing close to 900 gravity stations which were "loop" method surveyed for accurate elevation control.

7. The area covered in this recent work is over 7000 feet long and for the most part 4000 feet wide. A Scintrex (C.G.2) gravimeter was utilized exclusively on the project.

8. The raw gravimetric data was corrected for drift, elevation and latitude by standard procedures using electronic calculators. Maps of the results accompany this report.

9. Two strong gravity peaks are present close to the north zone, and two additional peaks within 2000 feet of the north zone have been designated anomalies "A" through "D" inclusive. Anomaly "A", the highest amplitude, is some 2.06 milligals above the regional average.

10. A spherical model causative body was used to calculate excess mass and tonnage of heavy material of a density close to that of barite (ie. 8 cubic feet per short ton was utilized whereas pure barite averages 7.12 cubic feet per short ton). Anomalies A, B and D fit the spherical model quite well based on profile determinations whereas anomaly C is an extremely poor fit. Calculations are based on a host rock density of 2.6, a causative body density of 4.2 or an excess density of 1.6. (Note: the density of pure barite is 4.3 to 4.5.)

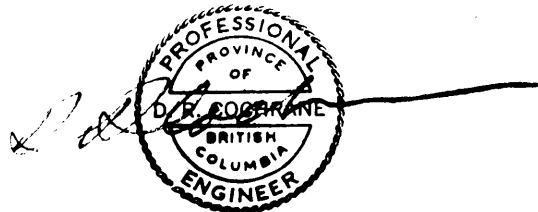
11. The results of the calculations are presented below:

<u>Anomaly Number</u>	<u>Location (in 100's feet)</u>	<u>Peak Value Above Regional (milligals)</u>	<u>Excess Mass (short tons)</u>	<u>Tonnage in sphere at 8 cu. ft. per short ton</u>
A	1.5E;52.5N	2.06	700,000	1,750,000
B	2.0W;55N	1.00	360,000	900,000
C	12.0W;55N	2.00	340,000	850,000
D	14.0E;40N	0.57	<u>200,000</u>	<u>500,000</u>
Totals:-			1,600,000	4,000,000

Several additional, but more subtle peaks were outlined in the Barite Hill area, close to areas of barite "showings".

12. In view of (a) the short supply of drill mud grade barite; (b) the oil and gas drilling activity in the Arctic; (c) the presence of an excellent grade of barite in pods and lenses in bulldozer trenches on the claims; (d) the unexplained induced polarization and gravity anomalies present on the Atan Lake property, investigation as to the cause of these anomalies is recommended. The most expedient method of determining the cause of the near surface anomalies would be drilling.

Respectfully submitted,



D.R. Cochrane, P.Eng.

July 16, 1973
Delta, B.C.

PART B

1. LOCATION AND ACCESS:

The Atan Lake property is situated immediately east of the now abandoned settlement of McDame Post on the Dease River, Northern British Columbia. Normal access is by 4x4 truck, as follows: west from the town of Watson Lake, Yukon, to Mile 650 of the Alaska Highway; south from this point on the Cassiar road, and past Good Hope Lake to the McDame Post Road (a distance of approximately 60 miles); thence southeast on the McDame Post Road to Dease River and east one mile to the camp. The Alaska Highway and Cassiar Roads are all-weather gravel roads; however, some washouts do occasionally occur during the spring run-off. The McDame Post Road is a narrow dirt track often impassable after a heavy rain. A network of cat roads has been constructed from camp and provide facile access to most parts of the claim group. Atan Lake and the Dease River are sufficiently large to accommodate a float-equipped light aircraft. The nearest air base is in Watson Lake, approximately 70 miles north of McDame Post (Figure 1, Location Map).

2. CLAIMS AND OWNERSHIP:

Tournigan Mining Explorations Ltd., with an office at 704 - 535 Thurlow Street, Vancouver, B.C. owns outright 43 located contiguous, full-sized claims and 3 fractions in the Liard Mining Division. The claims are grouped, and the record numbers are as follows:

ATAN GROUP:

<u>Claim Name</u>	<u>Record Numbers</u>	<u>Expiry Dates</u>
Atan No. 1 - 4	28358-28361	Sept. 28/'78
Atan No. 5 & 6	28362-28363	Sept. 28/'77
Fox No. 1	26935	May 16/'77
Adair No. 1 - 8	26936-26943	May 16/'77
Ski No. 1 & 2	26948-26949	May 16/'79
Ski No. 3	26950	May 16/'80
Ski No. 4	26951	May 16/'79
Ski No. 5 - 18	26952-26965	May 16/'77
Wolf No. 1	26927	May 16/'78
Wolf No. 3	26929	May 16/'78
Wolf No. 5	26931	May 16/'78
Wolf No. 7	26933	May 16/'78
Fraction "A" Fr.	38159	June 24/'76
Fraction "B" Fr.	38160	June 24/'76
Fraction "C" Fr.	38161	June 24/'76

AUGUST GROUP:

August No. 1 - 6	31212-31217	Aug. 5/'73
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Several Claim posts were inspected by the author, and claims appear to be staked in accordance with the regulations set out in the Mineral Act of the Province of British Columbia. Some slight overlap of the Ski No. 5 claim occurs in the west property sector, with the Bill claims owned by Dresser Magcobar Industries Ltd. (See Figure 2, Claims Sketch).

There has been a restriction placed on staking mineral claims in the Dease River, as this area is reserve; for the British Columbia Railway. The reserve is a right-of-way for the proposed northerly rail extension from Dease Lake.

3. GENERAL SETTING:

The Atan claim group is situated close to the east boundary of the Stikine Range of the Cassiar Mountain Physiographic Division of British Columbia; and immediately west of the Liard Plain. The immediate area is a reasonable rugged mountainous region exhibiting many features characteristic of a complex geologic history and alpine glaciation. The highest peak in the vicinity is Blackfox Mountain, rising to 7,022 feet above mean sea level. The Dease River flows northeasterly through the mountains within a broad "U" shaped valley (elevation just less than 2,500 feet above mean sea level). The property is situated within this valley, at the foot of an unnamed peak which rises to over 6,000 feet to the north of the area surveyed. Geological mapping by H. Gabrielse (2) shows that the claims lie on the west flank of an anti-clinorium, composed of a lower Paleozoic and upper Proterozoic miogeosynclinal rock sequences. The area close to the claims was mapped as Upper Atan Group, consisting mainly of limestones and dolomites with minor interbedded shales.

Exploration interest is centered primarily on a fairly narrow dolomite-limestone member which, in places, is quite oolitic and sometimes brecciated. It is similar in many respects to a "reef type" limestone. This member, between McDame and Mt. Haskin (a distance of 16 miles) is host to five mineral occurrences (including Tournigan Mining's) (Ref. 2, ppg. 113-116). These prospects are characterized by similar mineral assemblages, and include galena, sphalerite, pyrite, chalcopyrite and pyrrhotite. In the case of the most southerly two prospects (Carlick Group or the Bill claims, and the Tournigan Mining showings) barite is abundant and occurs with minor siderite.

4. PREVIOUS WORK:

The first recorded observation of the Atan Lake occurrence was by G.M. Dawson (ref. Appendix II) in 1887. He reported an "argentiferous lead occurrence", situated a mile down river from McDame Post, and on what is now the Adair and Atan claims, Gabrielse (2) reports that in 1949, Beal Carlick staked a group of claims 2 miles north of McDame on what is now the Bill Claims, owned by Dresser-Magcobar Ltd. Gabrielse visited the showings, and described the occurrence as follows: "Galena is the chief metallic mineral and is commonly coarse grained. Minor pyrite, sphalerite, asurite and malachite occur in the deposit. Coarse-grained barite is abundant and occurs with minor siderite" (ref. 1, p.113). A few claims were staked in the Atan Lake area by local prospectors in the 60's, but allowed to lapse in 1967. During the same year, Tournigan Mining Explorations Ltd. located claims in the Atan Lake area, and added a few claims and fractions in subsequent years.

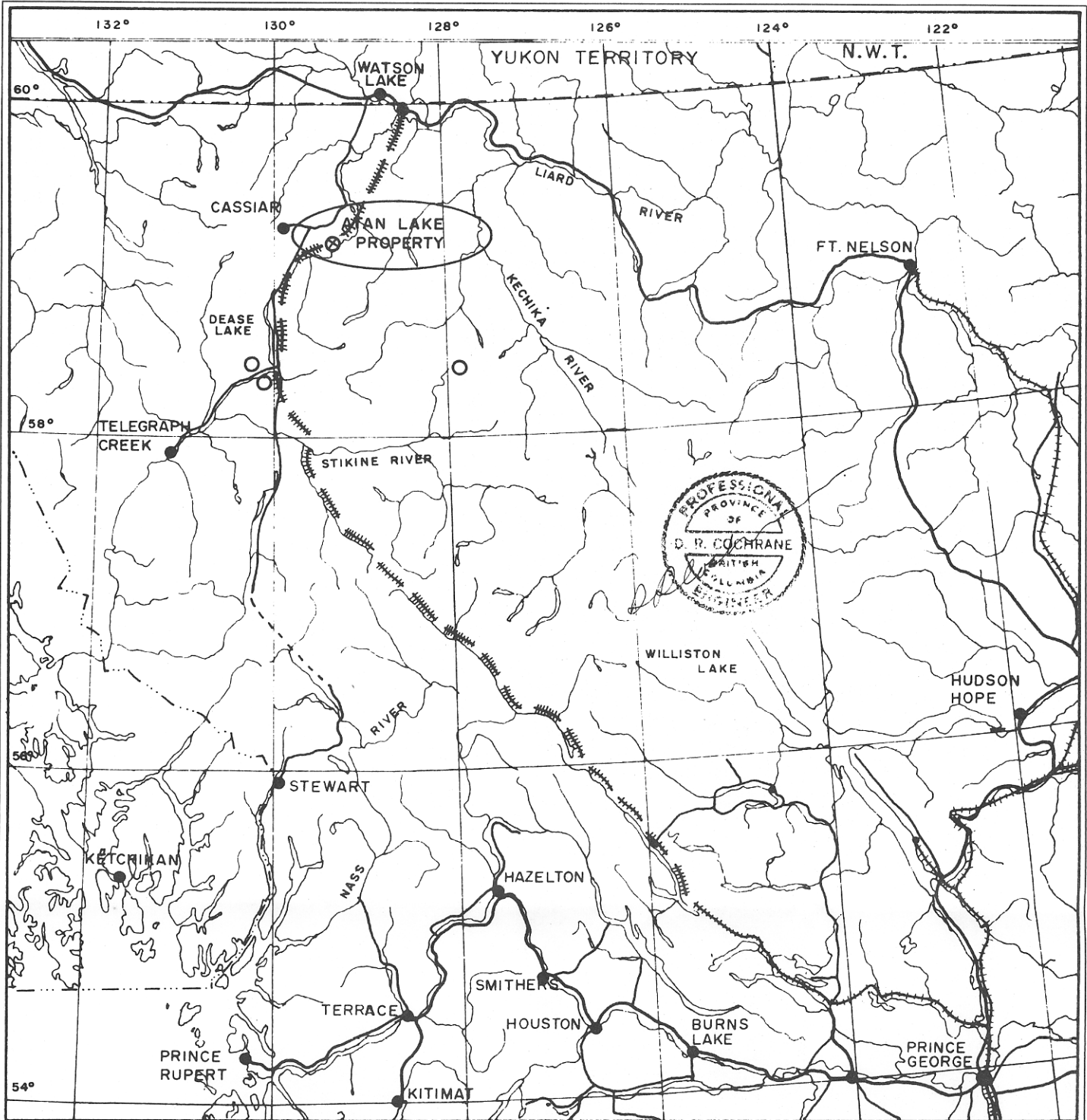
In August 1968, a field crew employed by Geo-X Surveys Ltd., and supervised by the author, completed a total of 12 line miles of an induced polarization and geochemical soil sampling survey over the southwest half of the property (ref. 3). Several strong chargeability anomalies were discovered and some of these correlated with weak Zn, Cu and Pb geochemical soil anomalies. Computer processing of this data is described in a paper presented at a Symposium on Decision Making (Ref. 5).

In the summer of 1969, a program of trenching, geological mapping and diamond drilling was carried out on two of the three chargeability anomalies, (ref. 4). The three drill holes, which tested the southern IP anomaly, immediately south of Atan Lake, encountered minor barite, pyrite, magnesite and scattered amounts of malachite, chalcopyrite and pyrrhotite in a brecciated oolitic dolomite-limestone sequence. Bulldozer trenching on IP Anomaly No. 3 situated just over 3,000 feet northwest of IP Anomaly No. 1 exposed lenses and patches of barite, in an impure limestone member, with knots of galena, and traces of chalcocite, tetrahedrite and chalcopyrite. Trenching on chargeability Anomaly No. 2 was attempted but bedrock was not exposed.

In the fall of 1970, New Jersey Zinc Exploration Company (Canada) Ltd. optioned the claims and conducted a gravity test survey over a portion of the grid area, (ref. 6). The results showed a residual gravity peak of 2.17 milligals coinciding with the high chargeability anomaly designated No. 3. H.E. Swanson,

(Geophysicist with New Jersey Zinc Co.) estimated 4½ million tons of excess mass in the IP anomaly No. 3 area, assuming that there is no overburden correction (that is, the overburden is only a few feet thick throughout). Mr. M. Lewis "guesstimated" an excess mass of greater than 3 million tons (ref. 9).

In the fall of 1972, a bulldozer trenching and geological mapping program was initiated and most of the work was centered on the north zone coincident with IP and Gravity anomaly No. 3. One trench, excavated to a depth of 7 feet, cut 24 feet of massive barite with minor copper stain and blebs of galena. Pods and lenses of barite have now been partially exposed within an area approximately 1,000 feet long and 500 feet wide in the north zone, and within an area approximately 400 feet in diameter on Barite hill, which is 3,500 feet southeast of the North zone. The area inbetween these showings is overburden covered and partially flooded by Atan Lake.



LEGEND

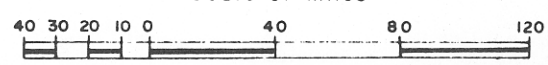
- ##### P.G.E. Rlwy.
- ## ## P.G.E. (proposed)
- Highways
- Cities and Towns
- ⊗ Properties

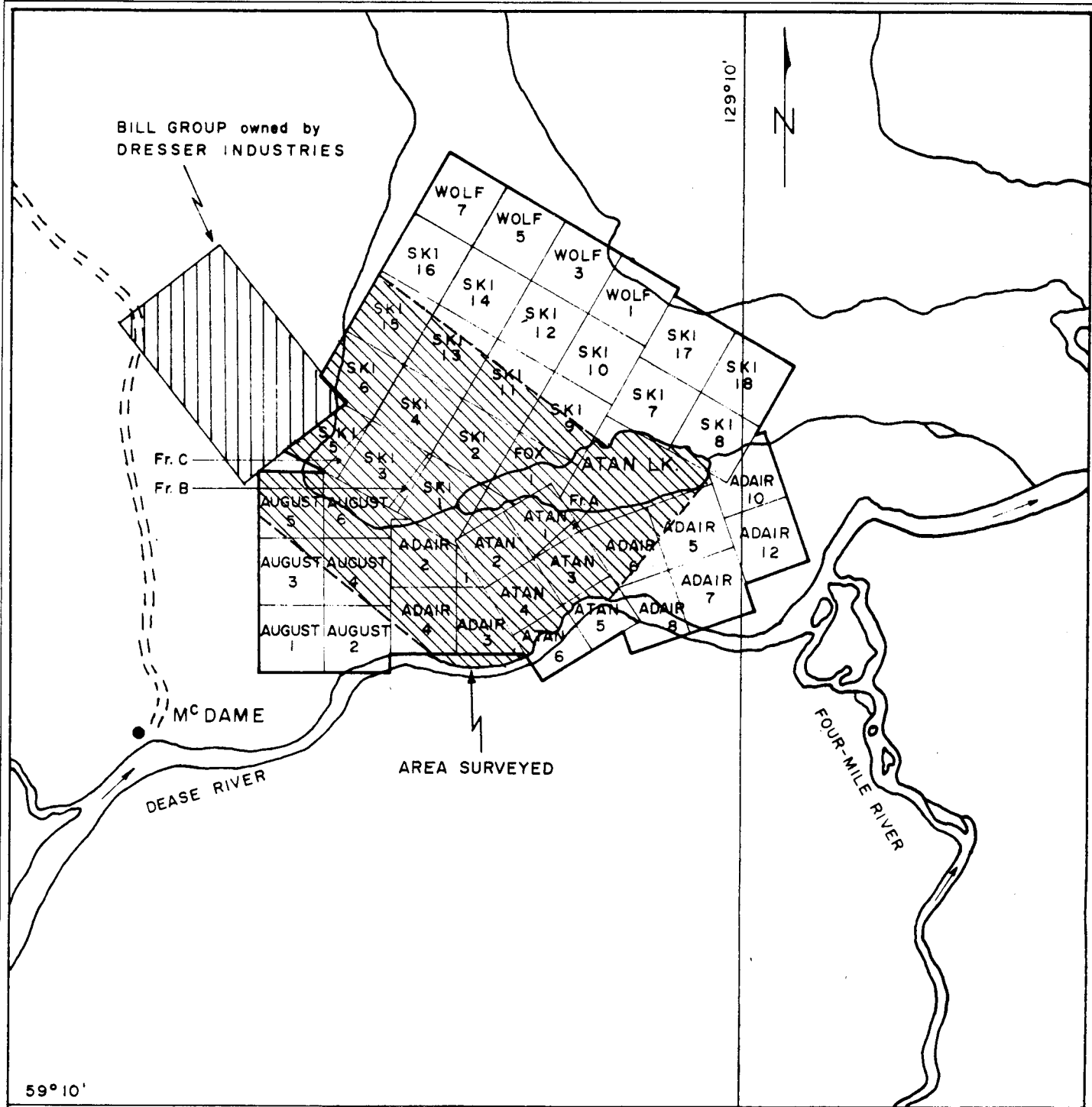
FIGURE 1

TOURNIGAN MINING EXPLORATIONS LTD.
LOCATION MAP
ATAN LAKE PROPERTY

To accompany report by
 D.R. Cochrane, P. Eng.
 on the Atan Lake
 Property in the Liard M.D.
 located 58 miles N.N.E
 from Dease Lake, B.C.
 Dated July 20, 1973 at
 Delta, B.C.

Scale of miles





59° 10'

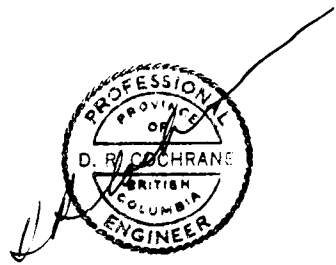
TOURNIGAN MINING EXPLORATIONS LTD.

ATAN LAKE PROPERTY CLAIMS MAP

FIGURE 2



To accompany report by D.R. Cochrane, P. Eng on the Atan Lake Property dated July 20, 1973 at Delta, B.C.



PART C - METHODS

C-1 WINTER GRAVITY WORK

A Scintrex CG-2 gravimeter was used exclusively on the survey in conjunction with a transit survey. The majority of the work was conducted on the ice of Atan Lake, and this lake work included the measurement and recording of 178 gravity stations at 100-foot intervals along lines spaced 250 feet apart. In addition, a total of 50 water depth soundings were recorded for interpretive purposes, and on a 250'x250' grid pattern across the lake. Several land base stations were also established in order that further work could be properly tied into the recently completed winter gravity survey.

The land traverse was completed along a portion of the base line from the lake towards the north zone, and then easterly to the winter camp main base station. This line was surveyed with a transit, and latitude, departures and elevations for each land station was calculated.

The gravimeter was "checked in" to the winter gravity base station located on winter camp point at least once per hour, in order that time-drift corrections could be applied to the data.

A magnetometer survey of the lake also completed, and a Scintrex MF-2 vertical component fluxgate magnetometer was deployed. A total of 186 stations were observed on the lake ice on the same grid pattern as the gravity grid.

C-2 WINTER GRAVITY DATA PROCESSING

The raw meter readings were corrected for drift by classical graphic time-drift procedures. The drift corrected meter readings were then multiplied by the meter constant (CG-2 serial #196) of 0.10114 milligals per division. A latitude correction was then applied to compensate for the oblateness of the earth. A contoured map of the depth of water in Atan Lake was then prepared using the 50 depth soundings obtained in the winter. From this information, 24 profiles were calculated for the gravity effect at surface of a two dimensional body subtended at the lower surface by an "N" dimensional polygon. This procedure compensated for the reduction in gravity due to the lake water. A density of 1.6 units was used (ie. water at 1.0, plus 1.6 = 2.6 the average density of the Atan Lake rocks). The calculated effect of the "filling in" of Atan Lake with host rocks of a density of 2.6 was then added to the observed gravity readings to produce a corrected gravity reading at each of the 178 gravity points. Finally, since the summer

gravity work recorded observations on winter gravity stations, a constant was added to winter gravity data in order that summer and winter gravity information would be compatible for contouring purposes.

C-3 SUMMER GRAVITY WORK

A main gravity base station was prepared on the first day of work and is located some 150 feet west of the cabin at camp. A secondary station (designated B-0) was also established at the point 39+64 north on the central base line. These stations were monitored at least once per hour for drift correction purposes.

Two tie lines were cut out, chained, blazed and flagged and the west tie line runs parallel to the base line at an azimuth of 312° and is 2000 feet south west of the base line. The east tie line is 2000 feet north east of and is also parallel to the base line. A north boundary, and south boundary were also cut, chained and blazed. The base line, an "L" shaped outside boundary, was then surveyed, and the elevation of the top of each wooden peg was determined from an arbitrary elevation established at 40+64 N on the base line. This latter position was designated 2450.00 feet above sea level. Elevations were determined by using stadia in steep terrain, and by bench mark leveling in gentle terrain. The cross lines between the surveyed cut line were then "brushed" out and numbered pegs driven into the ground and the elevation of the top of the pegs determined by transit stadia or B.M. leveling. Thus there was a check point elevation tie in at three positions along most of the cross lines. Due to steep bluffs on the south side of Atan Lake however, lines 10N and 15N on the east side were left "open". Elevations were recorded and calculated to 1/100th of a foot and the maximum check in error was 0.30 feet.

The 700 plus control stations were then metered and the gravity meter operator recorded the station number; height (H.I.) of the meter tripod; time of observation; and meter value.

C-4 SUMMER GRAVITY DATA PROCESSING

The raw gravimeter readings were corrected for drift by a graphic time versus drift method. The drift corrected reading was then multiplied by the meter constant (0.10114 milligals per division) to give the observed gravity. The height of the meter tripod was

added to the height (above sea level) of the top of each station peg and this "h" inserted into the combined free air and Bouger formula.

$$E = (0.09406 - 0.01276 d) h$$

Where d = the density and a value of 2.6 was used.

The latitude 59°12' passes through Atan Lake and all readings were corrected to this latitude by using the gradient formula.

$$L_C = \frac{1.307 \sin 2\theta}{5280} \times (\pm) y$$

where L_C = latitude correction

θ = latitude (i.e. 59°12')

y = the distance in feet north or south of 59°12' that the reading was observed.

The final corrected gravity value then is

$$C_g = E \pm L_C + O_g$$

where C_g = corrected gravity

E = free air / Bouger correction

L_C = latitude correction

O_g = observed gravity value.

In order to facilitate plotting, a constant value of 193.00 was subtracted from each C_g . The gravity station at Watson Lake (sta. W.A. 476) at the air terminal, has a recorded value of 981.7143, and the value calculated for Atan Lake (by the geodetic formula for the International Ellipsoid) is approximately 982.0 and thus since many of the plotted values are in the 4.0 range a constant of 978 may be added to plotted value to obtain an idea of the actual gravity.

PART D - DISCUSSION OF RESULTS

The corrected gravity observations of Atan Lake varied from a low of 0.83 to a high of 5.34 m.gals. and the arithmetic mean of a random sample of 50 values is 3.67. A frequency histogram also prepared from 50 random values shows a multimodal distribution with the primary mode in the 4.0 to (but not including) 4.5 range. The histogram is negatively skewed and there is some indication that two families of values exist family A in the 1.0 to 3.5 range, and family B in 3.0 to 5.5 range.

In general, the isogravimetric trends (See figure #4) are westerly directed however trends are somewhat poorly defined. There are several major disruptions on the overall pattern, the most noticeable occurring along a southwest-northwest trending line which passes through the north west end of Atan Lake. A second major disruption is subparallel to the Atan Lake linear, and is situated just north of the north zone, and crosses the base line near 57+50N on the base line. These major changes suggest the presence of major faults. Mr. N. Mistry (M.S. Geology) in a report to Tournigan Mining Explorations dated August 23, 1972, stated "trenching....., exposed a favourable recrystallized limestone horizon striking from 300° - 315° (azimuth), dipping 45° - 60° to the south west interbedded with minor horizons of arenaceous dolomites and argillites. The dolomitic limestone breccia is coarse grained and buff to buff/grey in colour on the surfaces, and is the host rock carrying assemblages of a coarse-grained galena, silver, tetrahedrite, abundant and sparse sphalerite.

The gravity work showed only faint isogravimetric trends along the strike direction, and thus the geophysical work must be only slightly lithologically biased. Several major gravity highs were located in the geophysical work, and these have been designated anomalies A, B, C and D respectively. Anomaly "A" peaks at 2.06 milligals above the regional background, and is centered at station S-33, at a point 1+50' off the base line on line 52+50N. A north directed profile across this anomaly was prepared and is shown in figure "6A". A sphere type model was fitted to the observed values and gravity values were calculated using the following data:

σ_c = density contrast = 1.6 (i.e. host rocks average density $\sigma = 2.6$; $2.6 + 1.6 = 4.2$; close to the density value for barite)

$X_{1/2}$ = half width = $\frac{230}{2}$ feet

G_p = peak residual value = 2.06 milligals.

From the above parameters the depth of burial of the sphere was calculated, the radii of the sphere, the volume and excess tonnage of the sphere, and the tonnage of the spherical model if composed of a material averaging 8.0 cubic feet per ton (ie. close to that of barite). Finally the theoretical gravity effect of the sphere was calculated and plotted on the profile. This procedure was repeated for anomalies B, C and D. The results are presented in tabular form below.

Anomaly Number	Gravity Sta. No.	Center at	Peak Value (milligals)	Depth to Center (ft.)	Radius Sphere (ft.)	Excess Mass (short tons)	Tonnage at 8 cu.ft. per ton
A	S-33	1+50E;52+50N	2.06	150'	150'	700,000	1,750,000
B	G-1	2+00W;55N	1.00	130'	106'	360,000	900,000
C	G-10	12+00W;55N	2.00	75'	117'	340,000	850,000
D	K-10	14+00E;40N	0.57	230'	98'	200,000	500,000
Totals:						1,600,000	4,000,000

Anomalies A, B and D show good correlation between observed gravity and calculated gravity for a spherical model. Anomaly C shows extremely poor correlation.

Several, more subtle gravity peaks occur on and around Barite Hill, some 3500 feet south of anomaly "D" and these include the following:

Gravity Sta.	Center At	Peak Observed Value
△3		4.79
BA-5		3.93
TO-3		5.01
-	10N;10E	5.30

A broad "J" shaped high occurs on the base line, and immediately to the east of the base line just north of Barite Hill and south of Atan Lake. The plus 5 milligal zone is some 1000 feet along the bottom of the J, and over 1000 feet long in the other direction. The gravity surface is rather gentle in this area, where a large geologic feature is possibly the cause, and a moderately deep seated causative body is inferred.

APPENDIX III

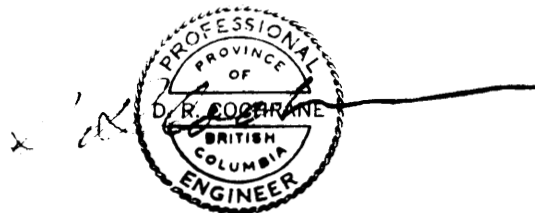
CERTIFICATE

I, D.R. Cochrane, of the Municipality of Delta, Province of British Columbia, hereby certify that:

1. I am a geological engineer with an office at 4882 Delta Street, Delta, B.C.
2. I am a graduate of the University of Toronto (B.A.Sc.) in 1962, and a graduate of Queen's University (M.Sc.Eng.) in 1964.
3. I have practiced my profession since 1962, while employed with U.S. Steel, Noranda Explorations and Meridian Syndicate.
4. I am a member of the Association of Professional Engineers of British Columbia and also the Association of Professional Engineers of Ontario and Saskatchewan.
5. I have no interest, direct or indirect, in the property or securities of Tournigan Mining Explorations Ltd., nor do I expect to receive any such interest.
6. The foregoing report is based on my association with the Atan Property since 1968, and personal visits to the property in 1968, 1970, 1971, 1972 and 1973.
7. I hereby consent to have the information contained herein used by Tournigan Mining Explorations Ltd., or in any official or unofficial communications they might have.

4882 Delta Street,
Delta, B.C.

D.R. Cochrane, P.Eng.



APPENDIX V

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