# GEOPHYSICAL REPORT

## MONEY CREEK PROSPECT, WOLVERINE LAKE, S.E. YUKON

FOR

ATNA RESOURCES LTD



BY

DELTA GEOSCIENCE LTD

DECEMBER 5, 1995.

GRANT A. HENDRICKSON, P.GEO.

TABLE OF CONTENTS

150 Meter Coil Separation Work:



50 Meter Coil Separation Work:

## INTRODUCTION

At the request of Atna Resources Ltd., Delta Geoscience has conducted a Horizontal Co-Planar Loop Electromagnetic (Maxmin) survey of Atna's Money Creek prospect. The survey area is located in the southeastern Yukon, near Wolverine Lake.

The exploration target is volcanogenic massive sulphide style mineralization hosted in an intercalated sequence of volcanics and metasedimentary rocks. Recent significant mineral discoveries in the area has renewed exploration interest in this area.

The geophysical work described in this report was conducted during the period October 1 to October 18, 1995.

In all, 15 kms of multifrequency horizontal co-planar loop EM was completed during the survey period.

The survey area is sub-alpine. The grid lies on an east facing slope that averages 20 degrees. This slope is incised by three creeks which have exposed the bedrock, and some zones of significant sulphide mineralization.

Since this report is to be appended to the geologic reports, no location, grid or claim maps will be included. Please refer to the geologic reports for these maps and a more detailed description of the geology and mineralization.

## PERSONNEL

Matthew Chamberlain - Geophysicist, Field Crew Chief.
Will Kahlert - Field assistant provided by Atna.
Grant Hendrickson - Geophysicist, Supervisor.

## EQUIPMENT

1 - Apex Parametrics Maxmin 1-9-MMC Electromagnetic System.
1 - Toshiba 5200 Field Computer.
1 - Fujitsu Printer/Plotter.

DATA PRESENTATION

The horizontal co-planar loop EM data is presented in stacked profile plans of the inphase and quadrature components for each frequency and coil separation. These maps have been produced at 1:5000 scale.

Profile data is presented increasing to the top of the maps (north) from a base level (value at the line position).

Conductor axes are shown on the 7040Hz plan (Fig. #7), by bold black lines and on the reduced scale quadrature plan of all the frequencies (Fig. #5R).

The quadrature response at 7040Hz has also been contoured at one degree intervals to help establish a good view of the spatial intensity and line to line correlation of the data (Fig. #1). The low values (negative numbers which are also shown by the deep blue colour), represent the area of higher conductivity or lower resistivity. This map, which has been provided both in colour and black and white, has also been reduced to page size (Fig. #1R), to facilitate the quick viewing of the data. Note that the scale in these reduced maps will be 1 cm = 150 meters.

In addition, the inclinometer data from the Maxmin survey has allowed us to produce a grid contour topography map (Fig. #2). This map has also been reduced to page size (Fig. #2R). Slope profiles are also presented, (Fig. #3).

SURVEY PROCEDURE

Atna personnel ensured the Money Creek grid was established prior to the arrival of the Delta Geoscience geophysicist. Line separation is 100 meters, with station separations approximately slope corrected to 25 meters.

The horizontal co-planar loop EM surveying was done at six frequencies: 200, 440, 1760, 3520, 7040 and 14080 hertz. Note that only the northern half of the grid received coverage at the highest frequency (14080Hz). The bulk of the work was completed with a 100 meter coil separation. A minor amount of detailing work was also completed with a coil separations of 50 and 150 meters.

Note that the maximum depth of investigation for a horizontal co-planar loop EM system is generally considered to be 50% of the coil separation for vertical conductors and 100% of the coil separation for flat lying conductors.

Despite the fact that the grid chaining was slope corrected and the Maxmin receiver was programmed to compensate for the slope, significant in-phase noise remained in the data. This noise is due entirely to coil separation errors. To some extent, the chaining error problem is unavoidable in mountainous terrain. To further eliminate the noise, the in-phase response at 220Hz was used as a reference, i.e. the 220Hz in-phase signal was subtracted from the higher frequency in-phase responses. This procedure works well when the conductors of interest are weak to moderate conductors, i.e. no inphase response at 220Hz, which is certainly the case for the Money Creek survey area. Coil separation errors have essentially the same amplitude for each frequency, therefore the subtraction process largely eliminates the separation errors from the more important higher frequency data, without adversely affecting the anomalous responses. The 220Hz data was recorded in anticipation of its use to correct the higher frequency data.

The quadrature response is largely unaffected by coil separation and orientation errors and does respond better to very poor conductors. These two facts have proven very useful in evaluating and outlining the weak conductors at Money Creek (see Fig. #5).

DISCUSSION OF THE DATA

All of the conductors detected in this survey of Money Creek display poor conductivity, typically around the two ohm-m level. This conductivity generally occurs over narrow widths, 1-4 meters. Although these values for the conductivity are very typical of narrow graphitic zones within a metasedimentary package of rocks, they are also quite typical of many of the significant western Cordilleran VMS deposits. Clearly, the quadrature response at high frequency (Figs. #5 & 7), best outlines the weak conductors at Money Creek.

In general, the conductors display a prominent grid east dip that appears to vary from 30 to 60 degrees. Depth to the top of these weak conductors varies from 10 to 30 meters. The near surface trace of conductive zones is strongly affected by the relatively shallow dips and the steep topography of the survey area.

Four main conductive zones (A, B, C and D) were outlined by this survey and they are described further below. No priority is indicated by the lettering used for each zone.

The apparent thickening of conductors A and D coincide with the areas where the east facing slope has been deeply incised by east-west trending creeks. These creek valleys are giving us a window deeper into the stratigraphy. This window may indicate a thickening of the conductive zones at depth.

Note that the maximum depth of investigation for shallow dipping targets with the 100m coil separation, is approximately 60 meters. In any event, conductive targets deeper than 80 meters would not have been seen by this survey.

The minor amount of detail work, (Figs. #11 and 12), done with a 150m coil separation better detected anomaly C and confirmed the poor conductivity. The 50m detail work (Figs. #13 and 14), showed strong attenuation of the anomaly response, which suggests the conductors are at a depth close to the detection limit of the 50 meter coil separation.

CONDUCTOR A:

- centered at 5600N, 4875E.
- a long, narrow, weak conductor that appears to thicken to the north. This conductive zone thickens as it passes through the small creek valley at 5600N.
- grid northwest strike, depth to top 10 meters.

CONDUCTOR B:

- centered at 4800N, 4625E.
- a broad, weakly conductive zone that quickly pinches out to the south, yet remains wide open to the north. Western margin of this conductive zone not well defined by present survey coverage.
- the isolated, weaker conductive zone outlined between conductors A and B at approx. 5100N, 4725E, may also be significant.
- grid northwest strike, depth to top 10 meters.

CONDUCTOR C:

- centered at 4400N, 5075E.
- a series of grid north striking weak conductors that appear slightly deeper than zones A, B and D. Depth to top estimated to be 30 meters.
- the minor strike change and increased depth to top may be significant features. The dip of this zone is also much steeper, perhaps 60-80 degrees to the east.
- the trace of this series of conductors closely parallels the topography.

CONDUCTOR D:

- a long, narrow, weak conductor centered at 3800N, 4800E.
- the apparent localized thickening of this conductor at 4800E may be a significant feature and occurs in the creek valley.
- very prominent grid northwest strike, depth to top 10 meters.

## CONCLUSIONS AND RECOMMENDATIONS

Weak, but significant bedrock conductors have been outlined by the EM survey.

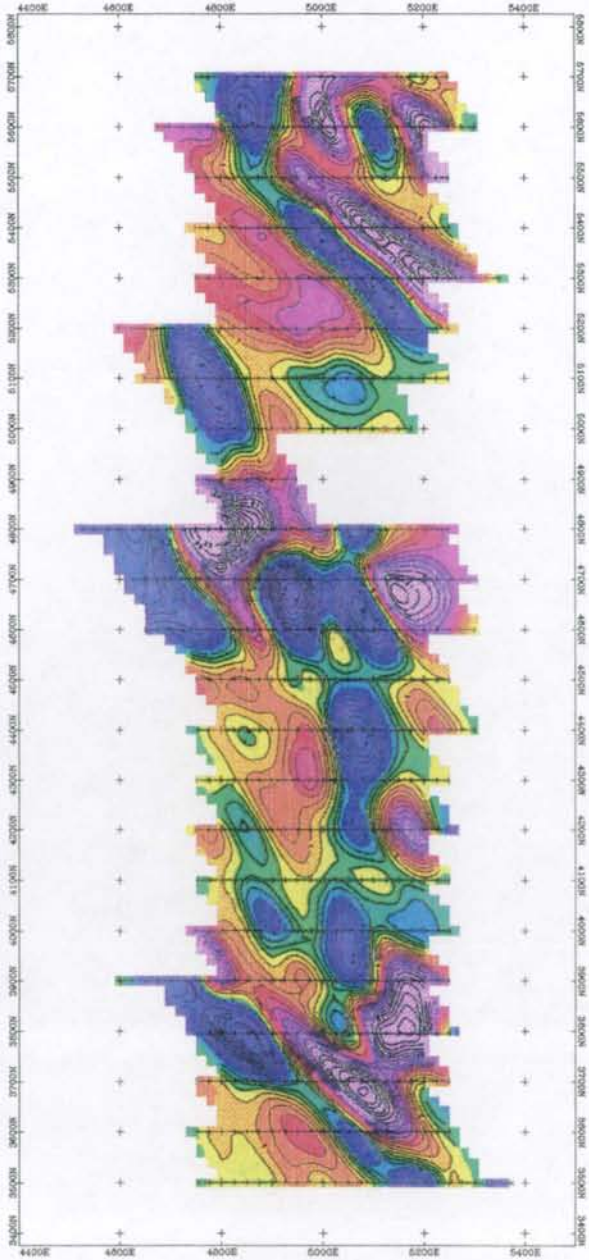
Based solely on the geophysics, it is difficult to assign priority to the individual conductive zones. The relative shallow nature to the occurrence of these conductors suggests soil geochemistry and prospecting data would help to further differentiate the conductors and establish priority drill targets.

All of the available magnetic data on this prospect should be compiled and colour contour maps produced at the same scale as the EM plans, to further differentiate the survey area geology.

The conductors outlined in this survey would very likely have been well defined by a VLF-EM survey. The fact that the VLF-EM survey can be done simultaneously, and at low cost, with the magnetic survey, supports routine grid coverage with these two techniques. The VLF-EM survey would not however replace the horizontal loop EM survey, but would be a useful adjunct.

G. Hendrickson

Grant A. Hendrickson, P.Geo.



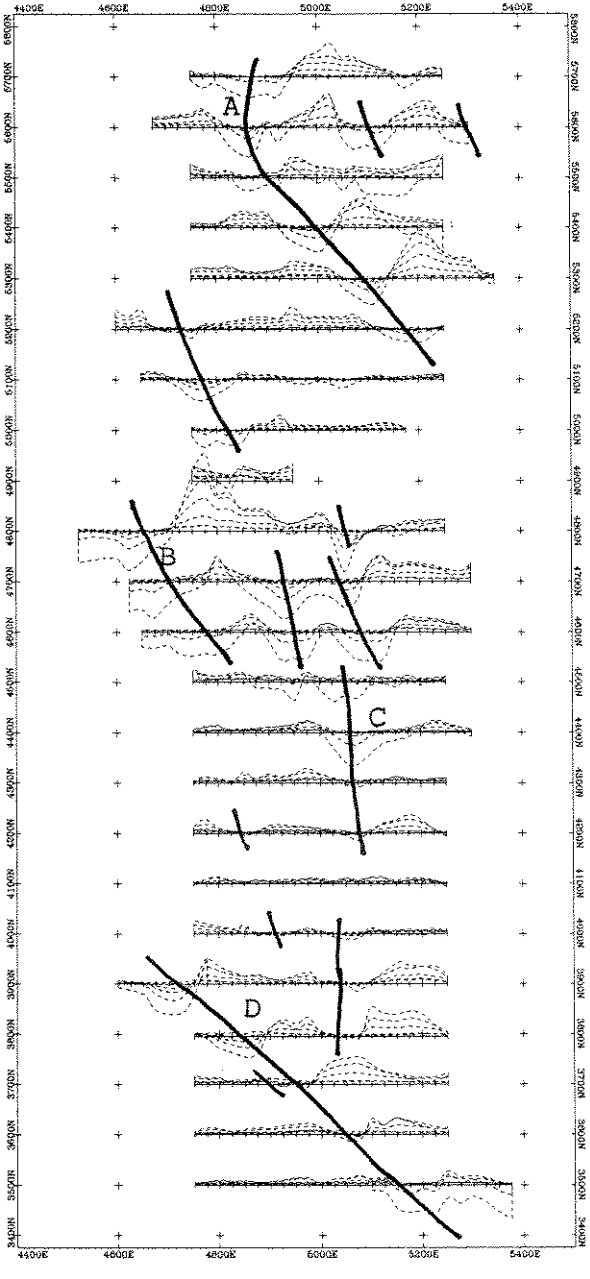

Scale reduced to 1cm = 150m.

ATNA RESOURCES LTD

HORIZ. COPLANAR LOOP EM QUADRATURE PLAN
SOUTHEAST ZONE

Frequency 1746 Hertz, Coil separation 150 meters
Quadrature response contoured @ 1 degree
Note, highest conductivities are dark blue

DELTA GEOSCIENCE LTD. Fig # 1R

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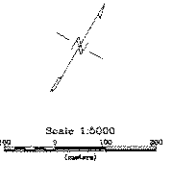


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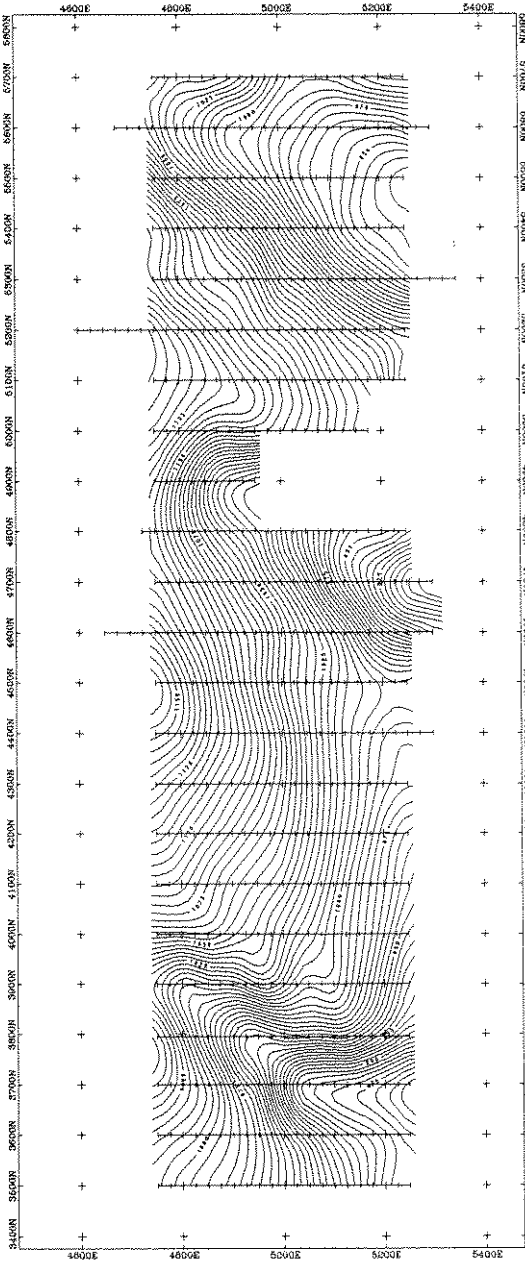
MONEY CREEK GRID
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequencies 220-14080 ht. Coil separation 100 meters
Quadrature response, dash line @ 1 cm = 20%
Quadrature for all 8 frequencies, base @ 0
October, 1996

DELTA GEOSCIENCE LTD. fig 15R

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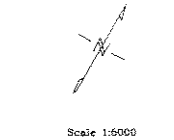
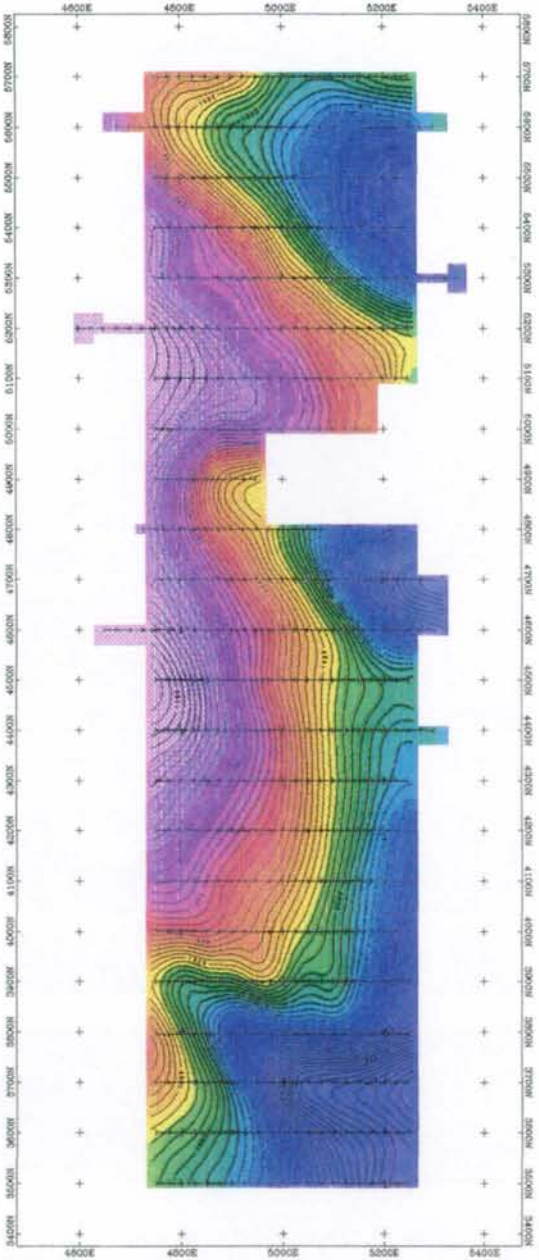



ATNA RESOURCES LTD

MONEY CREEK GRID
TOPOGRAPHY PLAN OF GRID
SOUTHEAST YUKON

Inclinometer data from MAXMIN survey
Contour interval 5 m., elev. datum arbitrary
relative accuracy approx. 1.5 meter
October, 1995

DELTA GEOSCIENCE LTD. fig # 2R




Scale reduced to 1cm = 150m.


ATNA RESOURCES LTD

MONEY CREEK GRID
TOPOGRAPHY PLAN OF GRID
SOUTHEAST YUKON

Inclinometer data from MAXMIN survey
Contour interval 5 m., elev. datum arbitrary
relative accuracy approx. 1.5 meter
October, 1996

DELTA GEOSCIENCE LTD. fig # 2R

REFERENCES

Fraser, D.C., 1969: Contouring of VLF-EM Data: Geophysics, Vol. 34, 958-967.

Karous, M., and Hjelt, S.E., 1983: Linear Filtering of V.L.F. Dip-Angle Measurements: Geophysical Prospecting.

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Ketola, M., and Puranen, M., 1967: Type curves for the interpretation of Horizontal Loop EM anomalies over tabular bodies: Geological Survey of Finland, Report on Investigations, N:01.

Apex Parametrics, 1980: Technical manuals on the Maxmin System.

STATEMENT OF QUALIFICATIONS

Grant A. Hendrickson.

- B.Science, University of British Columbia, Canada, 1971. Geophysics option.

- For the past 24 years, I have been actively involved in mineral exploration projects throughout Canada, the United States, Europe and Central and South America.

- Registered as a Professional Geoscientist with the Association of Professional Engineers and Geoscientists of the Province of British Columbia, Canada.

- Registered as a Professional Geophysicist with the Association of Professional Engineers, Geologists and Geophysicists of Alberta, Canada.

- Active member of the Society of Exploration Geophysicists, European Association of Exploration Geophysicists and the British Columbia Geophysical Society.

Dated at Delta, British Columbia, Canada, this 6 day of DEC, 1995.

G. Hendrickson

Grant A. Hendrickson, P.Geo.


093425

Scale 1:5000

100 0 100 200

(meters)

DWG (1)

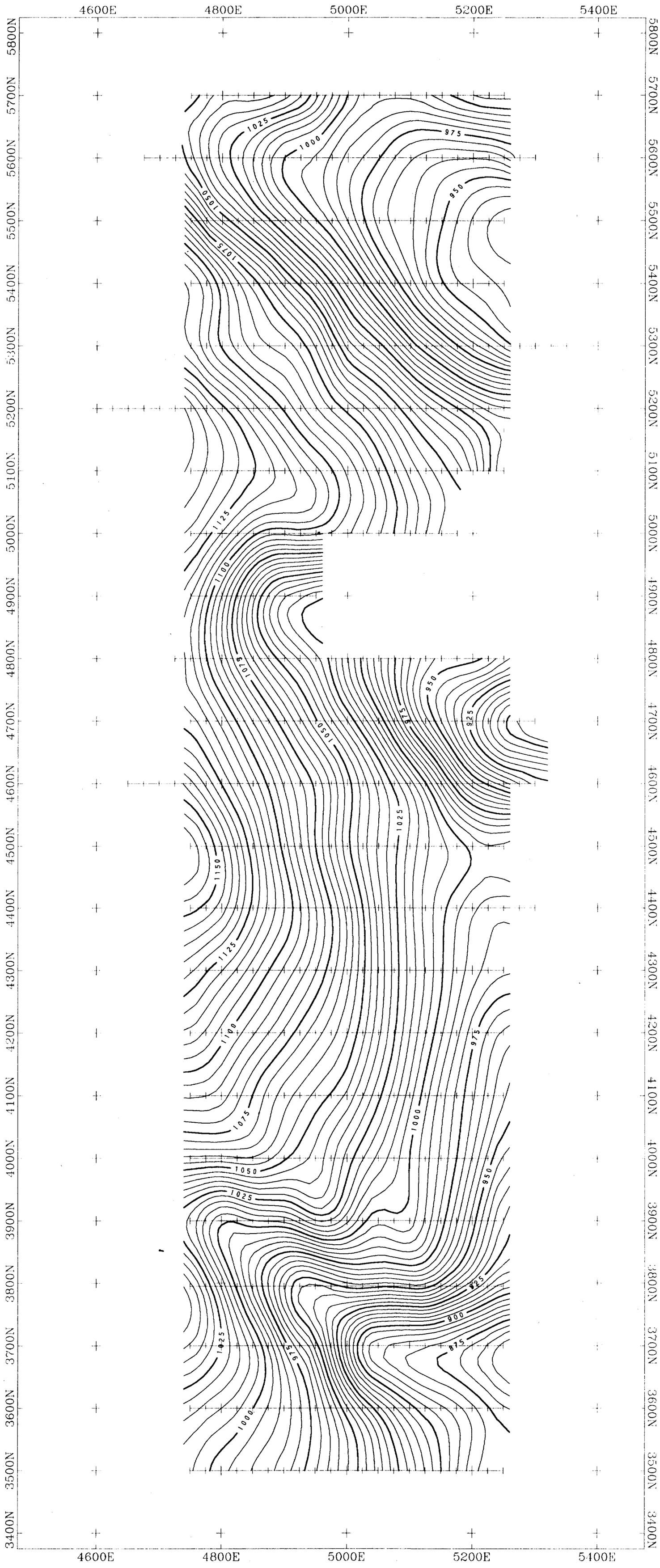
# ATNA RESOURCES LTD

**MONEY CREEK GRID**

HORIZ. COPLANAR LOOP EM QUADRATURE PLAN
SOUTHEAST YUKON

Frequency 7040 hz, Coil separation 100 meters
Quadrature response contoured @ 1 degree
Note, higher conductivity areas dark blue
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 1*




093425

Scale 1:5000

100 0 100 200

(meters)

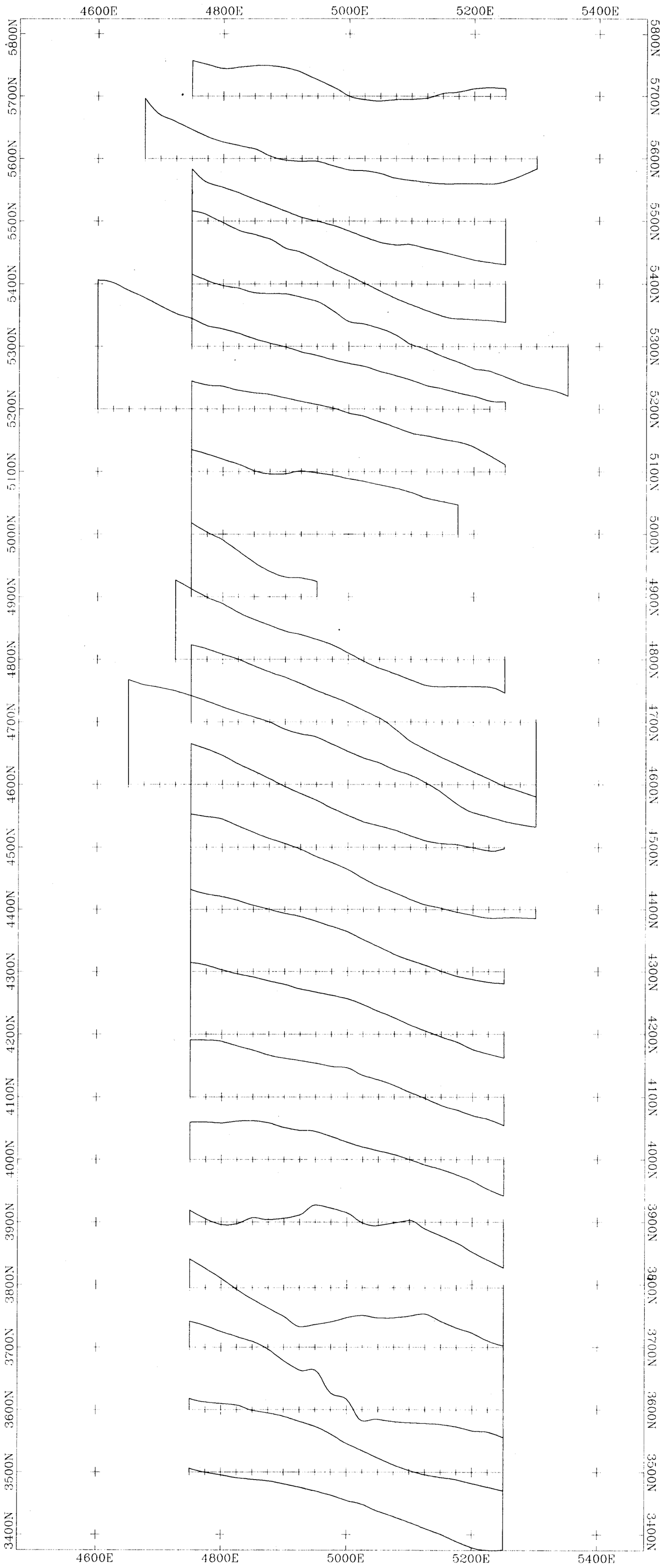
DWG ②

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
TOPOGRAPHY PLAN OF GRID
SOUTHEAST YUKON

Inclinometer data from MAXMIN survey
Contour interval 5 m., elev. datum arbitrary
relative accuracy approx. 1.5 meter
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 2*

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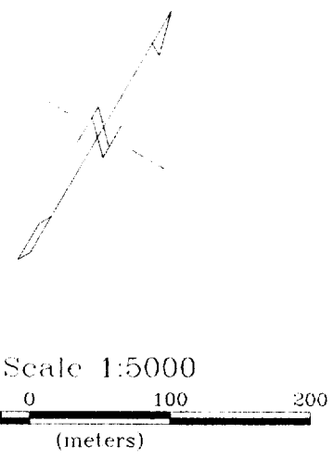


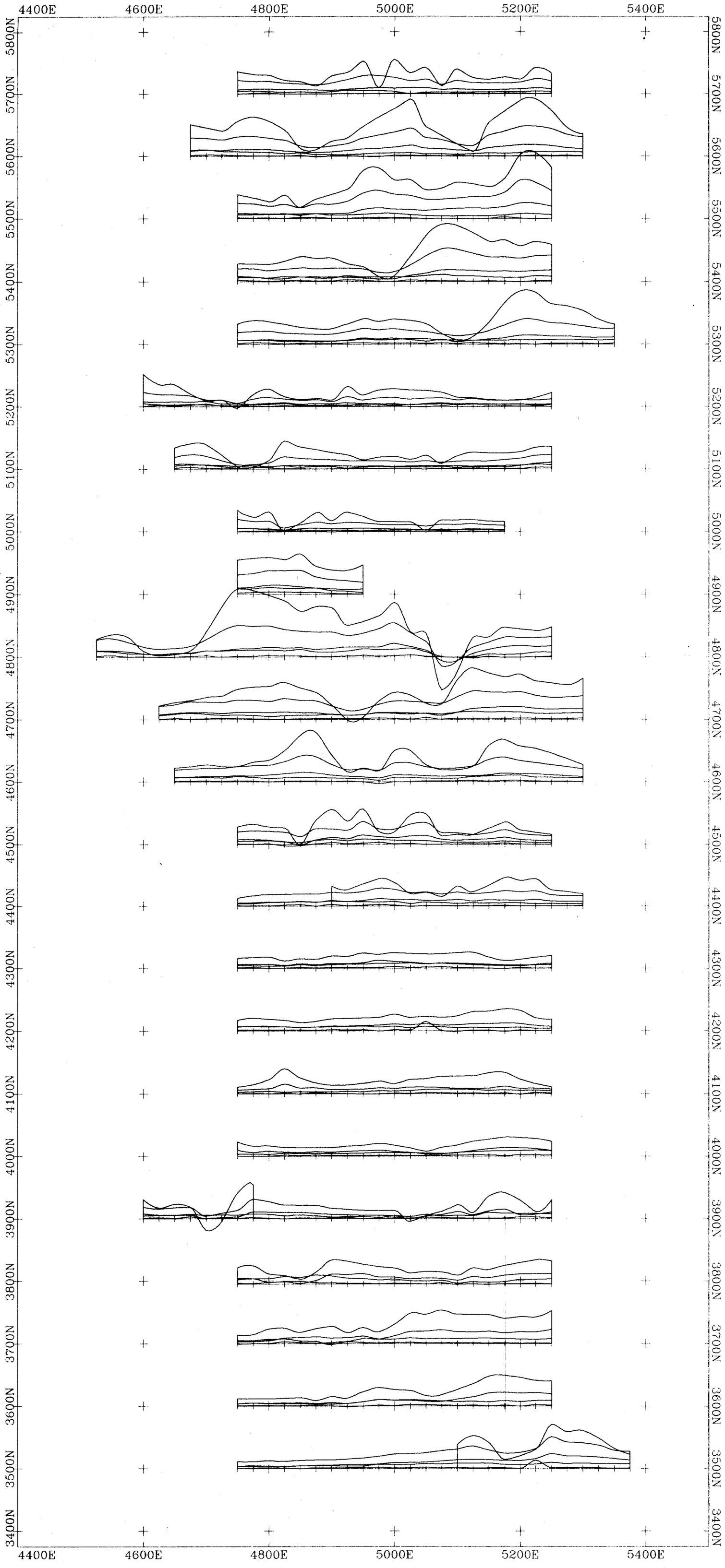

Dwg (3)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
TOPOGRAPHIC PROFILES OF SURVEY LINES
SOUTHEAST YUKON

Inclinometer data from MAXMIN survey
1 cm = 50 m., elev. datum not fixed to any BM
relative accuracy approx. 1.5 meter
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 3*




093425

Scale 1:5000

100 0 100 200

(meters)

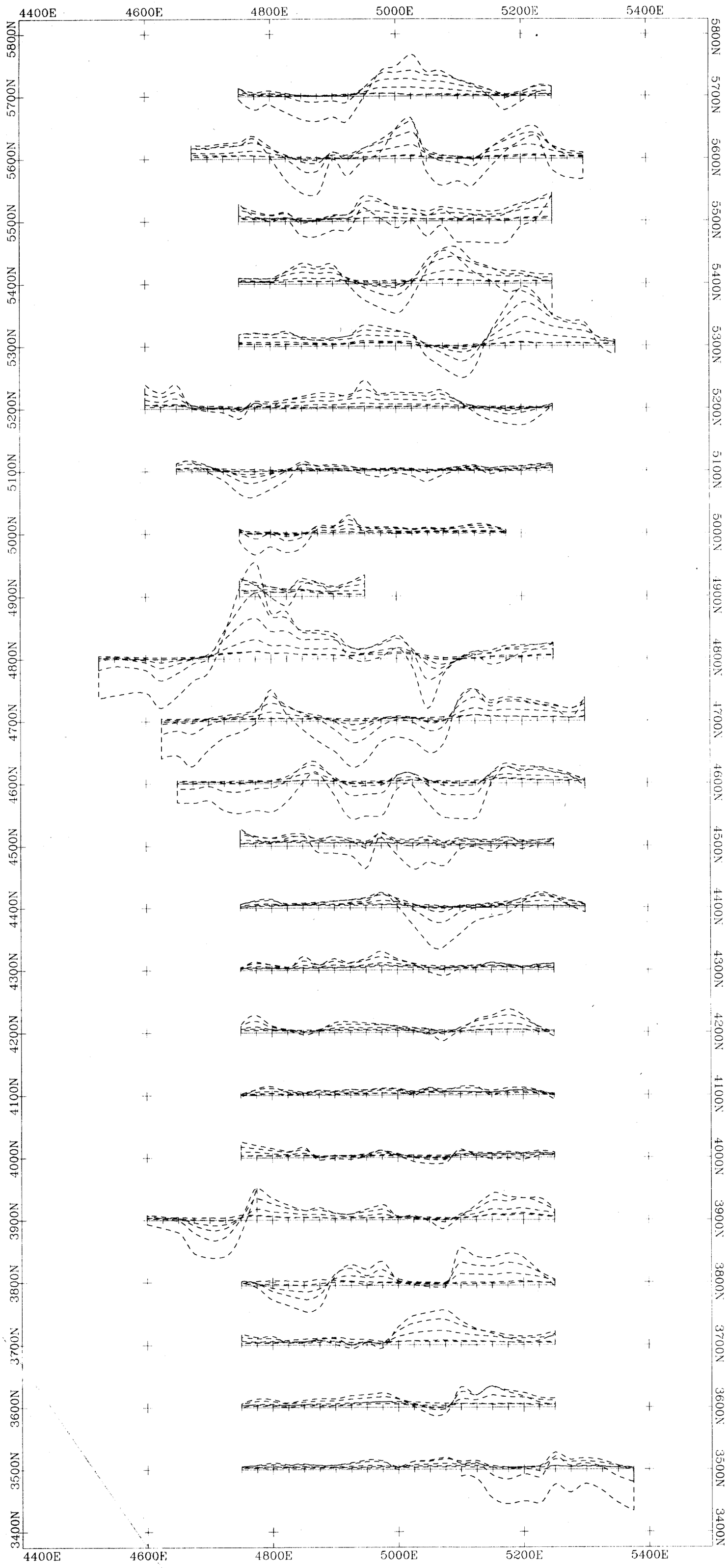
DWG (4)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequencies 440-14080 hz, Coil separation 100 meters
Inphase, corrected, solid line @ 1 cm = 20%
Inphase for all 5 frequencies, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* ***fig # 4***




093425

Scale 1:5000

100 0 100 200

(meters)

Dwg (5)

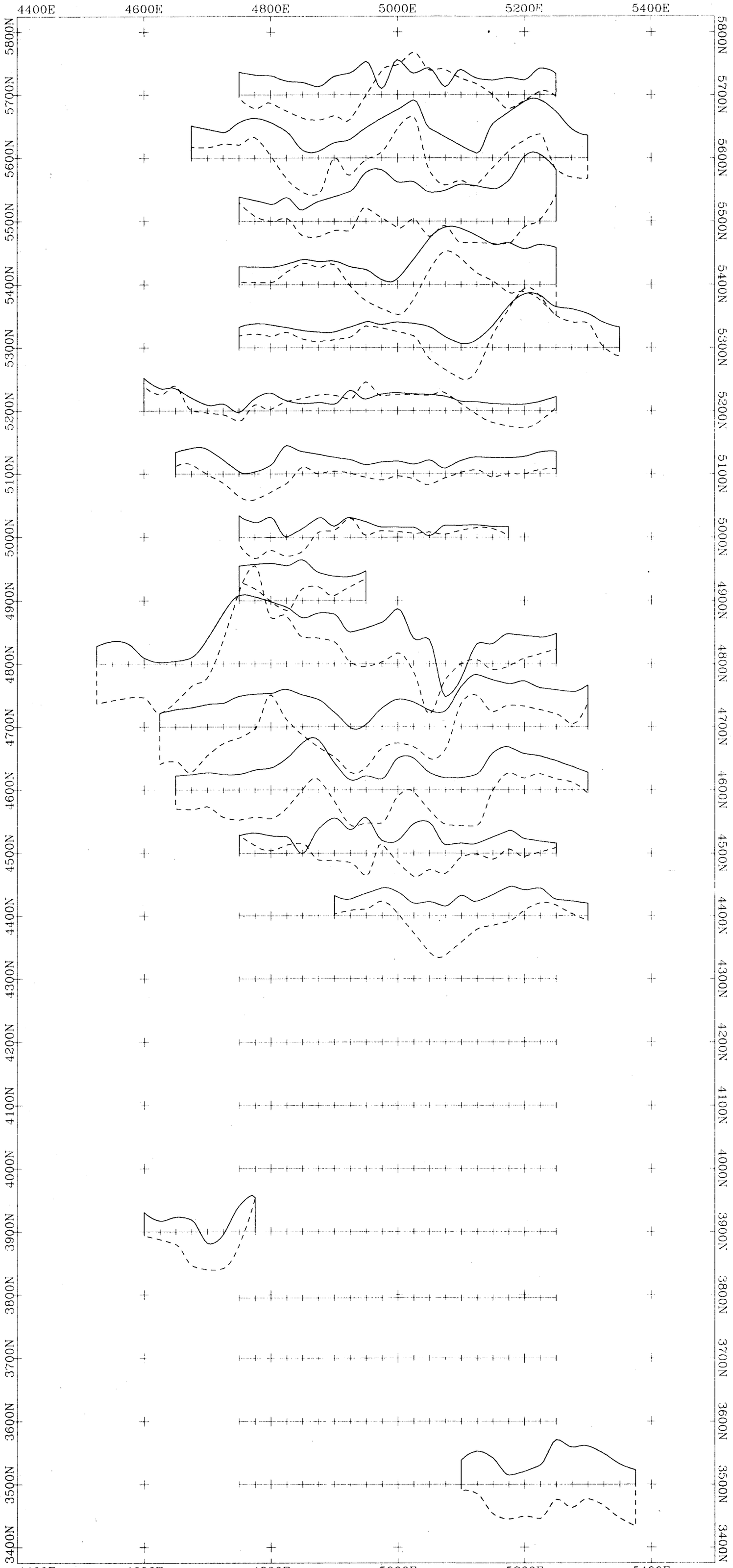
# ATNA RESOURCES LTD

**MONEY CREEK GRID**

HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequencies 220-14080 hz, Coil separation 100 meters
Quadrature response, dash line @ 1 cm = 20%
Quadrature for all 6 frequencies, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 5*




093425

Scale 1:5000

100 0 100 200

(meters)

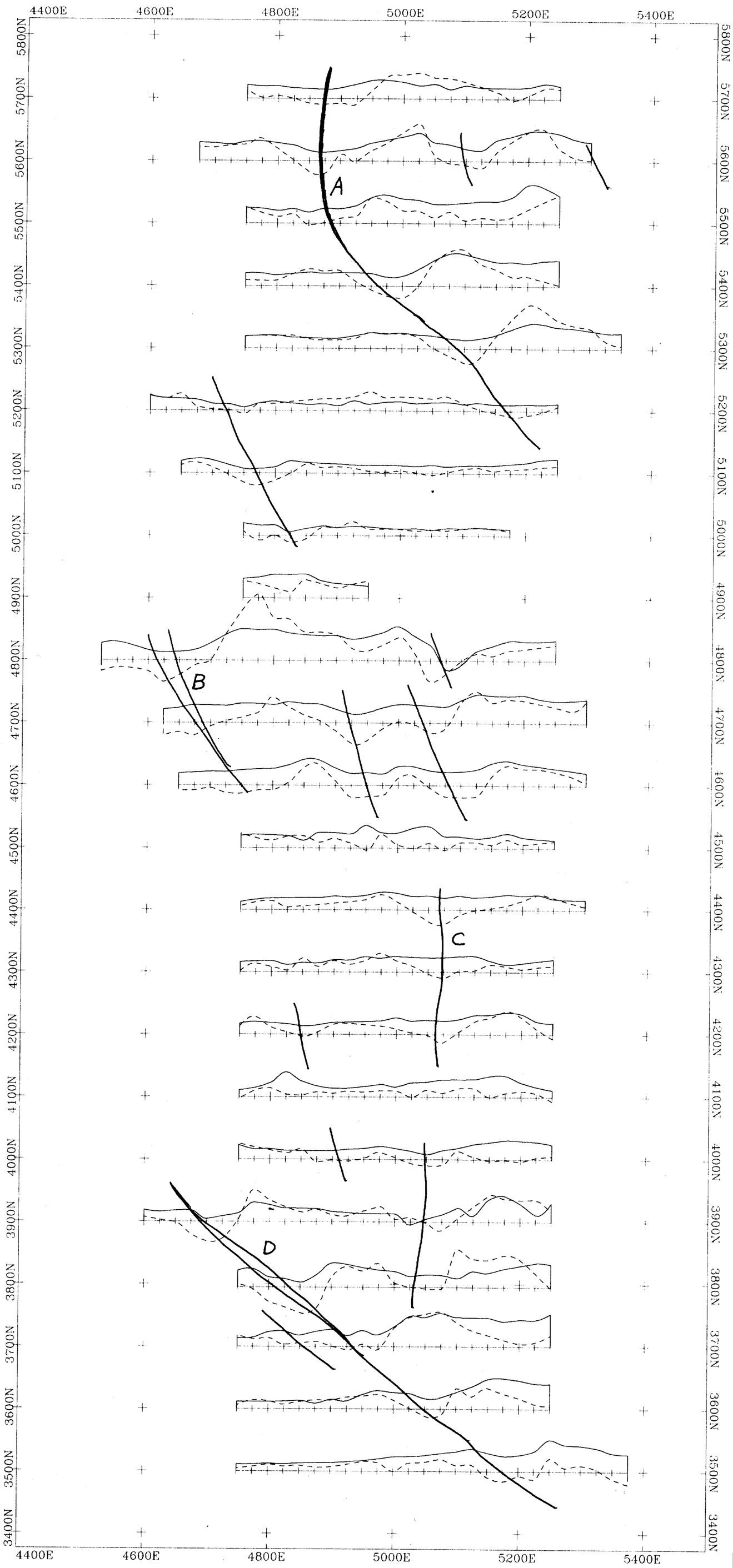
Dwg (6)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequency 14080 hz, Coil separation 100 meters
Inphase, corrected, solid line @ 1 cm = 20%
Quadrature dash line @ 1 cm = 20%, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 6*




093425

Scale 1:5000

100 0 100 200

(meters)

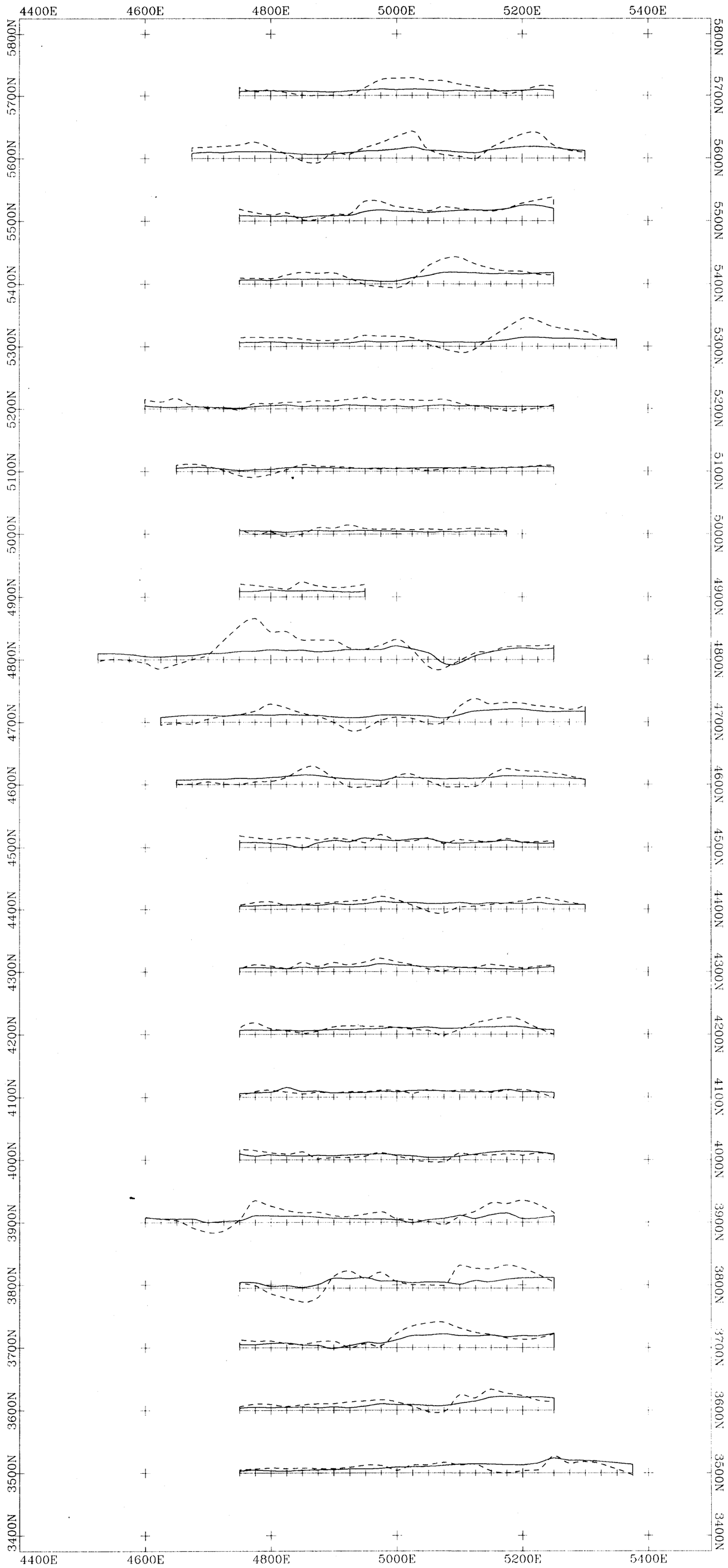
Dwg (7)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequency 7040 hz, Coil separation 100 meters
Inphase, corrected, solid line @ 1 cm = 20%
Quadrature dash line @ 1 cm = 20%, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 7*




093425

Scale 1:5000

100 0 100 200

(meters)

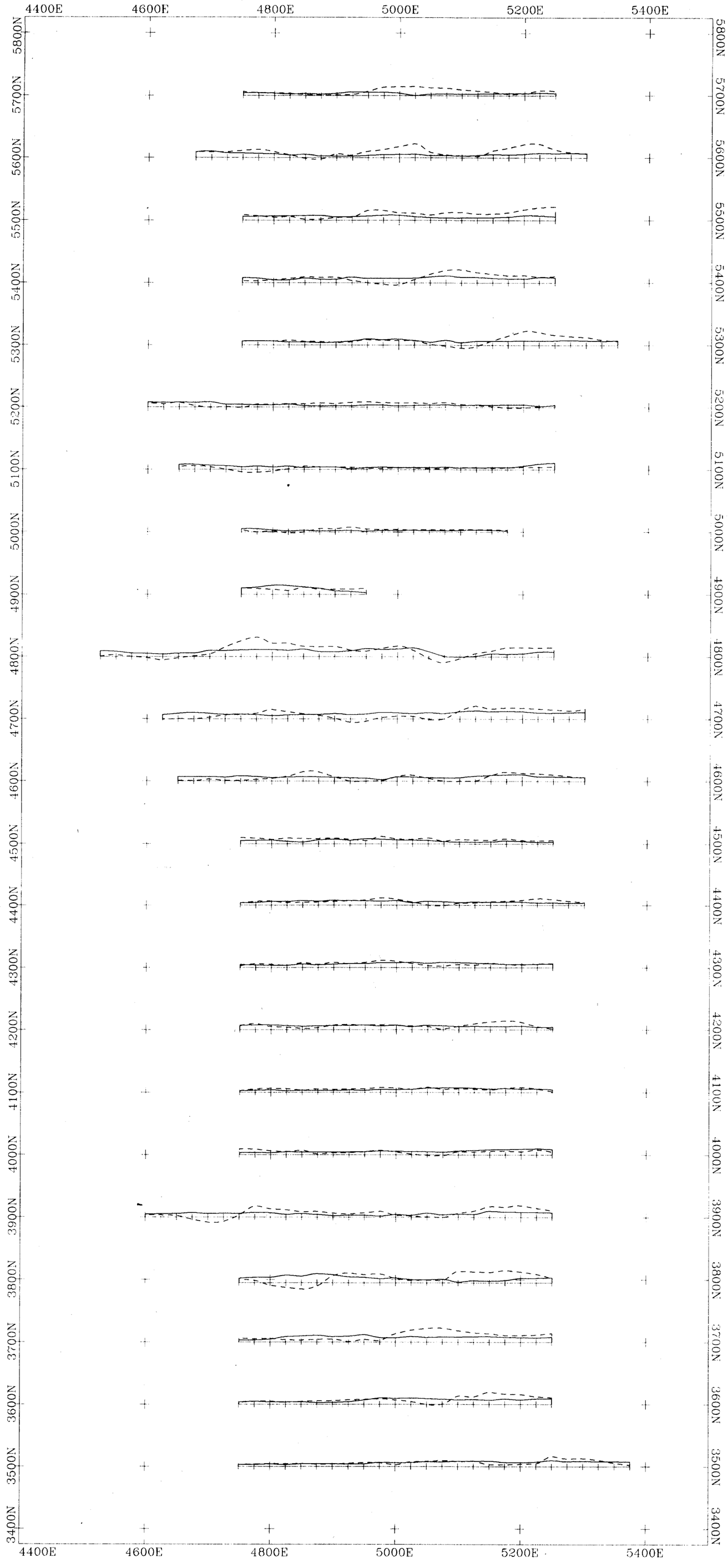
Dwg (8)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequency 3520 hz, Coil separation 100 meters
Inphase, corrected, solid line @ 1 cm = 20%
Quadrature dash line @ 1 cm = 20%, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 8*




093425

Scale 1:5000

100 0 100 200

(meters)

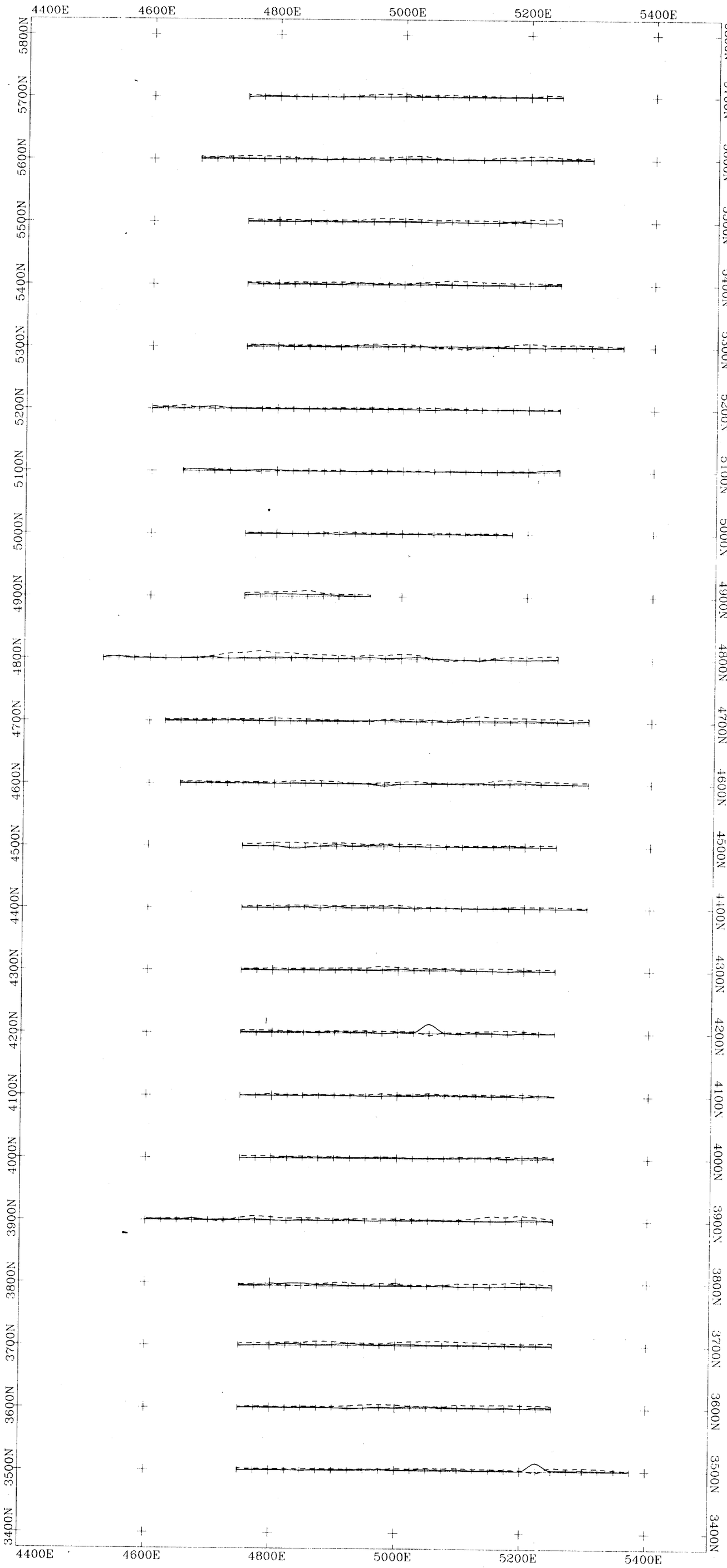
Dwg (9)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequency 1760 hz, Coil separation 100 meters
Inphase, corrected, solid line @ 1 cm = 20%
Quadrature dash line @ 1 cm = 20%, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 9*




093425

Scale 1:5000

100 0 100 200

(meters)

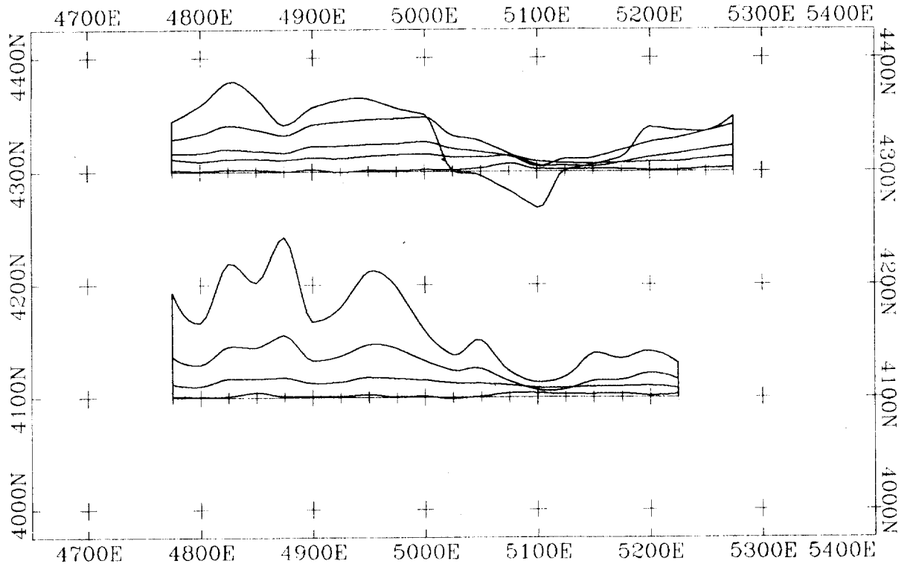
DWG (10)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequency 440 hz, Coil separation 100 meters
Inphase, corrected, solid line @ 1 cm = 20%
Quadrature dash line @ 1 cm = 20%, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 10*




09425

Scale 1:5000

50 0 50 100 150 200

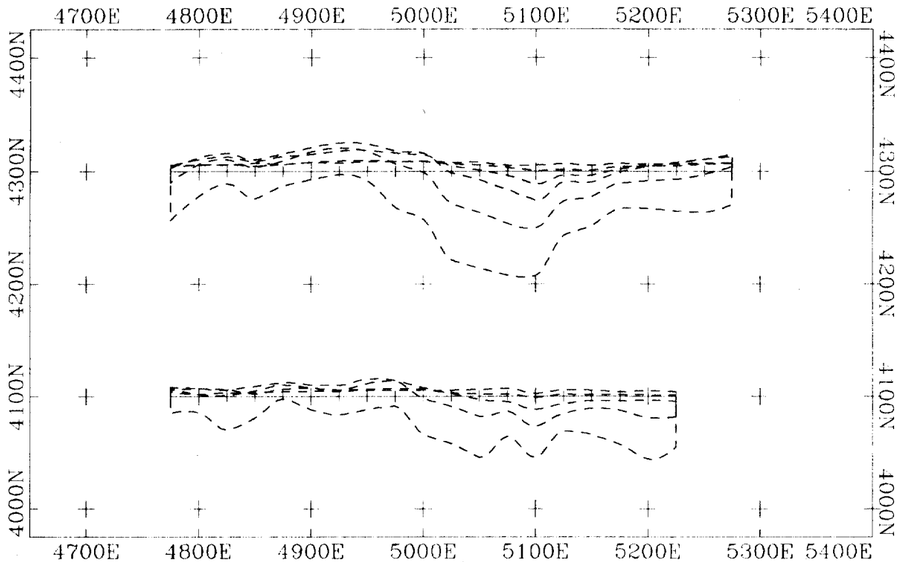
(meters)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZ. COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequencies 440-14080 hz, Coil separation 150 meters
Inphase, corrected, solid line @ 1 cm = 20 %
Inphase for all 5 frequencies, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 11*




093425

Scale 1:5000

50 0 50 100 150 200

(meters)

# ATNA RESOURCES LTD

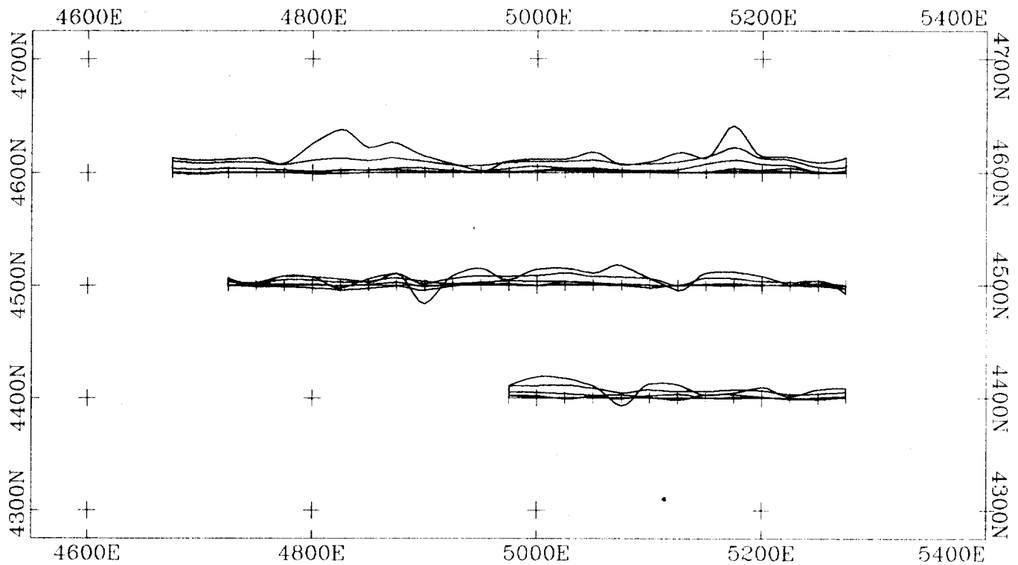
**MONEY CREEK GRID**

HORIZ. COPLANAR LOOP EM PROFILES

SOUTHEAST YUKON

Frequencies 220-14080 hz. Coil separation 150 meters
Quadrature response, dash line @ 1 cm = 20 %
Quadrature for all 6 frequencies, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 12*




093425

Scale 1:5000

100 0 100 200

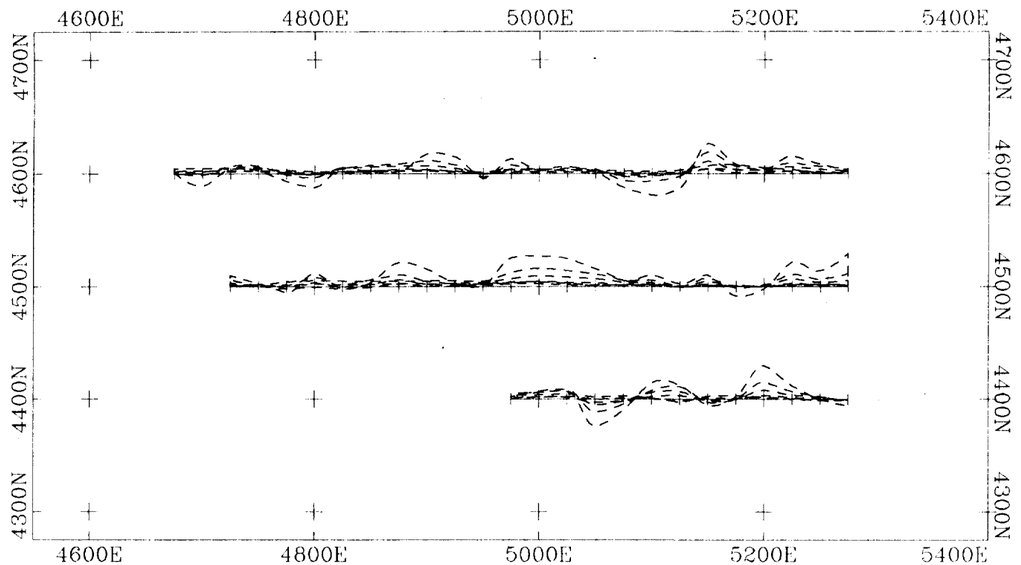
(meters)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequencies 440-14080 hz, Coil separation 50 meters
Inphase, corrected, solid line @ 1 cm = 20 %
Inphase for all 5 frequencies, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 13*

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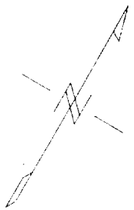

Scale 1:5000

100 0 100 200

(meters)

# ATNA RESOURCES LTD

**MONEY CREEK GRID**
HORIZONTAL COPLANAR LOOP EM PROFILES
SOUTHEAST YUKON

Frequencies 220-14080 hz, Coil separation 50 meters
Quadrature response, dash line @ 1 cm = 20 %
Quadrature for all 6 frequencies, base @ 0
October, 1995

*DELTA GEOSCIENCE LTD,* *fig # 14*