383001

AFMAG TEST
AT CYPRUS CR. ANOMALY 20/6

GEOPHYSICS

59-259

Anomaly 20/6
LEG 26/2/59

383E

000 LYELL - E.Z. - EXPLORATIONS

Q51, Q58
Q72, Q78, Q79

GP18

383002

26th February, 1959

To: Mr. G.F. Hudspeth.

McPhar Geophysics Ltd. Programme - January, 1959

Attached is the report of D.B. Sutherland for January. The report is self-explanatory.

Chief Geologist, L.E.E.

Activities of McPhar Crew - January, 1959

During this initial stage of the test program, all of the electrical apparatus was checked and tested under field conditions.

The Afmag method was tested in the following four localities: Mount Lyell, Cypress Creek, Mainwaring River and Moore's Valley. One drill hole, H.63R at Rosebery, was logged with the Drill Hole Electromagnetic Unit and the Vertical Coil System was used to survey the Mainwaring River grids. No line surveying was done with the Induced Polarisation apparatus.

The results of the tests will be the subject of separate reports. The following is a daily record of activities.

Jan. 7	Travelling - Toronto to Melbourne.
Jan. 8	Travelling - Toronto to Melbourne.
Jan. 9	Travelling - Melbourne to Queenstown.
Jan. 10	Uncrating and checking equipment.
Jan. 11	Afmag profile on King River track.
Jan. 12	Purchasing field clothes. Helicopter: Queenstown, Birch, Cypress Creek.
Jan. 13) 14) 15)	Afmag profiles on 20/6 - Cypress Creek.
Jan. 16	Travelling - Cypress, Strahan, Queenstown.
Jan. 17	Noise level checks with drill hole coils near power lines on Mount Owen. Night Afmag tests on Mount Lyell.
Jan. 18	Logging drill hole 63R - Rosebery.
Jan. 19	Travel - Queenstown, Strahan, Birch.
Jan. 20	Travel to 20/5 - Mainwaring River - making camp. Instructing M. Paltridge in E.M. method.
Jan. 21	E.M. Surveying. 20/5S. NightAfmag profile.

Jan. 22 E.M. Surveying. 20/5S. Afmag field low in evening.

Jan. 23 E.M. Surveying. 20/5S and 20/5N. Afmag field low in evening.

Jan. 24 Afmag profiles in afternoon - fields low and spikey - results questionable. Rain 4 p.m.

Jan. 25 Rain.

Jan. 26 Discussions with B. Scott. Arrival of magnetometer. Check and reset magnetometer. Sevenhuysen to Moore's Valley.

Jan. 27 Rain a.m. Instruction in magnetometer to M. Paltridge. Magnetometer surveying.

Jan. 28 Rain a.m. and p.m.

Jan. 29 Mag. 20/5 in a.m. Move to Moore's Valley in p.m. Afmag at night.

Jan. 30 Discussions with B. Scott. Afmag at night.

Jan. 31 Afmag at night. Check and test I.P. gear.

D.B. SUTHERLAND
McPHAR GEOPHYSICS

1st February, 1959

Afmag Test at Cypress Creek - Anomaly 20/6

The purpose of this test was to demonstrate the AFMAG system over a known strong conductor. The field work was carried out in a period of 3 days.

The Afmag fields were low during the daylight hours but reliable observations could be made after 10 a.m.

Lines 16S to 40S

Large dip angles and well-defined crossovers were obtained on each of these lines. Two strong conductors are evident. The first appears to be continuous from 1W on 16S to 4W on 32S and may continue at least as far as 36S. A second, en echelon, conductor has been interpreted as extending from 2W on 28S to 4W on 40S although the results on 32S are somewhat uncertain. Both of these anomalies display good conductivity. Their dip is difficult to determine due to the presence of other conductors but it appears to be either vertical or steeply west.

Weaker indications of smaller subsidiary conductors were found adjacent to the strong anomalies. These probably represent sub-parallel bands of similar high conductivity.

Indications of other minor zones of good conductivity were obtained on the western portion of the grid. Their locations are shown on the map. A reliable estimate of dip is not possible because of their proximity to much stronger anomalies.

Lines 60S and 64S

The results on these two lines indicate that a strong conductor is located to the west of the area surveyed.

A near-surface, steeply dipping zone of moderate conductivity is indicated to be near 1E on 60S and 64S. In addition a weaker conductor is indicated near 3E on line 64S.

Summary and Recommendations

The tests at Cypress Creek have provided examples of two important features of the Afmag method.

1. Relative Strength

A number of N.S. striking conductors have been resolved between 16S and 40S by the Afmag system. At the same time it has been indicated that the two zones lying near the base line are the strongest conductors.

2. Range

Although a conductor is evident near the baseline of 60S and 64S the dip angles indicate that a stronger anomaly is located to the west of the grid area. It is recommended that one of these lines be extended 1000 feet to the west to establish the location of this indicated zone.

D.B. SUTHERLAND
McPHAR GEOPHYSICS

1st February, 1959

Mainwaring River - Anomaly 20/5

It was intended to locate this airborne anomaly with the Afmag and to check those indications with electromagnetic and magnetic methods. However, the Afmag fields were found to be too low to be reliable and the electromagnetic method was used for the primary survey.

1. South Grid - 20/5S

Electromagnetic Survey

Four transmitter set-ups were used to cover this grid and the surveying was completed in 2½ field days. The initial results indicated that the conductors were located both east and west of the picketed area. Particularly high angles were encountered in the NE corner of the grid and additional surveying was carried out on pace and compass traverses over the area of interest. Excessive topography and heavy scrub prevented similar extensions on other parts of the grid.

Zone A

Zone A appears to be due to a single continuous structure between 2W on 38 and 2E on 50N and it probably continues further north. The profiles suggest that the conductor dips to the east and the relative magnitude of the 1000 and 5000 cps dip angles indicate that it consists of poorly conductive material throughout its length.

The anomaly strikes parallel to the schistosity in the underlying Owen Conglomerate and a small shear containing electrolytic solutions could be the cause of the anomaly.

Zone A is displaced 700 feet to the east of a high ratio airborne response and unless the airborne results have been misplotted, it seems doubtful that these two results were obtained from the same conductor.

Two weak indications are located near 7W on lines 38N and 42N but they could not be considered as the cause of the airborne anomaly.

Zones B & C

Two weak zones were traced for a distance of 1200 feet south of 38N. Zones B and C display poor conductivity and have been interpreted from weak indications. They may represent either two separate conductors extending southward from Zone A or the edges of a broad area of poor conductivity.

The profiles on lines 6N to 18N indicate that a poor conductor is located just east of 2E while a similar poor conductor is indicated to the west of 1E in the area between 22N and 30N. Similar results can be obtained from flat lying conductors but additional checking would be required to prove which interpretation is correct.

Magnetic Survey

Three short profiles were run across Zone A on lines 42N, 46N and 50N. None of these profiles revealed variations of more than 25 gamma. The reading error of the instrument is estimated at plus or minus 5 gamma. These profiles show that there is little or no magnetic relief associated with Zone A.

A profile was run on 26N between 6W and 12W in an attempt to locate the Lyell Shear which is believed to cross the line near 10W. Instead of the increase expected in this vicinity, a low of approximately 25 gammas was encountered. A diurnal variation of 30 gammas was observed during the course of this work and consequently there may be errors in the values on the west end of the line. In order to locate the Lyell Shear, line 26N should be extended a minimum of 600 feet to the west and resurveyed.

The above magnetic work was accomplished in one day. Additional surveying was not completed due to rain.

Summary and Recommendations

Three conductive zones were encountered on the South Grid but none of these were found to coincide with the location of the airborne anomalies. No magnetic relief was obtained over Zone A while Zones B and C were not checked with the magnetometer. All of these anomalies displayed similar poor conductivity and on the basis of the geophysical results are not considered worthy of further work. However, geological setting could increase their importance.

Since westward extensions are planned for several lines to locate the Lyell Shear, it is suggested that these be surveyed with electromagnetic unit to determine if the airborne anomaly has been misplotted in this direction.

2. North Grid - 20/15N

Three lines were run from a single set-up on the north grid. The results suggest that a poorly conductive zone, Zone D, extends across the grid and probably continues further north and south. Zone D corresponds closely with an airborne response.

Zone D is similar to the Zones located on the South Grid and, on the basis of the geophysical results above, no further work is considered warranted.

3. AFMAG Survey

The Afmag fields were low for the period from January 20 to 26 in this area. A test profile was run on 18N on the night on January 21. The results were similar to those found with the electromagnetic system but the reliability of the observations was quite low. Part of this profile was repeated during daylight on the 24th. The high frequency results agreed quite closely but variations of up to 10 degrees were obtained in the low frequency readings.

Additional observations taken during the afternoon of the 24th could not be repeated and it was concluded that in the absence of a strong conductor reliable results could not be obtained with present daytime fields.

D.B. SUTHERLAND
McPHAR GEOPHYSICS

1st February, 1959.

AFMAG Tests - Mount Lyell Area

As a demonstration of the AFMAG system, a test profile on line 2000 was run over the Corridor Anomaly which had been outlined with the Turam electromagnetic system. Massive sulphide mineralisation is known to lie beneath this anomaly.

Unfortunately the fields from local power lines were found to be excessive and completely masked the natural earth fields. It was possible, however, to obtain nulls on the power line field and its harmonics, and the profile was completed to see if interpretable results could be obtained. A marked change in dip in the N-S component was noted near the center of the Turam anomaly at 3400N. Wide nulls were encountered to the north of this point and in most cases nulls could not be obtained in the N-S orientation. Although these effects can be considered as evidence of a nearby conductor, they were not sufficiently well defined to encourage further investigation of the use of a dip angle method to investigate areas in the vicinity of power lines.

The use of a power lime as a transmitter for an electromagnetic system is perhaps feasible, but a two coil phase measuring device, similar to that used by the Turam system, is considered to be a better approach.

In order to determine the distance at which a power line would interfere with AFMAG system, a test profile was run along the King River track. Strong interference was obtained up to a distance of 9100 feet from the power line.

Since the natural earth fields are considerably stronger at night, a midnight test with the AFMAG was carried out on the west side of Mount

Lyell near Comstock. The power line field was found to be excessive and it can be concluded that the AFMAG system cannot be used successfully within 2 or 3 miles of the power lines near Mount Lyell.

D.B. SUTHERLAND
McPHAR GEOPHYSICS

1st February, 1959.

Afmag Method in Tasmania - January, 1959

In the Northern Hemisphere, good correlation has been found between the secular shift of thunderstorm centres and the levels of the Afmag fields; the strongest fields being present during the summer months of June, July and August. Maps of world wide distribution of thunderstorms show a marked increase in activity in the Southern Hemisphere during the corresponding season of January, February and March. Consequently it was recommended that the initial test be carried out in this period.

A study of the Afmag fields has been made during January from observations taken with the field dip angle system. This involves a set of discrete measurements and the information obtained is more qualitative than quantitative. However, the following characteristics have been noted.

1. Diurnal variation is similar to that observed in the northern hemisphere and also appears to be correlated with the height of the ionosphere.
2. The 480 c.p.s. fields are 3 to 10 less than those found in North America during the summer.
3. At 140 c.p.s. the fields appear to be even lower and, except for sharp spikes due to nearby disturbances, they are normally below the noise level of the instrument during daylight hours.
4. The low levels necessitate high gain settings on the equipment which increases the interference from thunderstorms, and microphonics and restricts field operation.

The reason for these unusually low levels is not known and there may be a variety of factors involved. One possibility, however, is the predominance of ocean covered areas in the Australasian region. Sea water is a good conductor and a major portion of the energy initiating in the Equatorial Belt may be attenuated by this medium. If this is valid then the effects would be more pronounced in Tasmania than on the Australian mainland. Attempts are being made to arrange for several days field testing in the Broken Hill area to check this possibility.

With the field levels observed to date reliable readings cannot be made during the day in the absence of strong conductors, (see Mainwaring report) and consequently a programme of night observations has been initiated to investigate the Moore's Valley area. A strong conductor, however, "sorts" the random pulses and orients them in a preferred direction. In the case of the Cypress Creek area this "sorting" was sufficient to allow continuous operation after 10 a.m. On the basis of these tests it would seem that additional checks on airborne anomalies would be worthwhile, particularly in areas of heavy scrub where line cutting is difficult.

A continuous record of the field level over an extended period is essential to the evaluation of the usefulness of the AFMAG system in Tasmania. Arrangements have already been made with Crossland Licensing Corporation for the loan of a continuous recording instrument and it is expected to arrive by March 15th. The continued operation of this unit after the completion of the McPhar contract is highly desirable and it is hoped that the method is considered sufficiently important to warrant it.

In our opinion, tests to date with the Afmag show that the method can be used successfully for primary exploration and airborne follow-up work in Tasmania, but, with present field levels and instrumentation the field operation is difficult and expensive. Nevertheless, continuation of both the Moore's Valley programme and selected airborne follow-up work is considered worthwhile.

When additional data has been obtained it is hoped that a means will be found to improve the system for future operations in this locale. A full report will be made at that time.

The possible application of airborne Afmag is considered remote at present.

D.B. SUTHERLAND
McPHAR GEOPHYSICS

1st February, 1959

Interim Report - Moore's Valley Area

This report covers the surveying carried out with the AFMAG system between 28th January and 2nd February. During this period the natural earth fields have been below operating level during most daylight hours, but stronger fields have been available in the early evening and at night. To date, all observations have been taken between the hours of 6 p.m. and 3 a.m. In the six nights since this procedure was initiated, usable fields were present on five nights and 12,000 feet of surveying has been accomplished.

The rate of surveying is somewhat less than had been anticipated and in order to cover the area of interest in a minimum period of time the traverse interval has been increased to 800 feet. Intermediate traverses at 400 feet intervals may be required to detail anomalous areas. It is intended that the interesting AFMAG anomalies be checked with the Induced Polarisation method.

Lines 28N, 36N and 44N

With the exception of the east part of line 28N, the dip angles are relatively constant and no variations suggesting a deeply buried conductor are apparent. The azimuth direction is roughly grid NE - SW.

On the eastern end of 28N the azimuth changes to grid N and a few sizeable dip angles have been obtained. In general these results indicate conductivity to the south of the line but further interpretation cannot be made until the results of line 20N are available.

Recommendations

A study of the dip angles at the two frequencies on the three lines completed to date shows that, except for an almost constant displacement of a few degrees, the high and low frequency curves are very similar. The high frequency fields are normally much higher than the low and it may be necessary, for the sake of production, to carry out the surveying at the high frequency alone until anomalous dip angles are encountered. Low frequency readings could then be made over the areas of interest in periods of strong fields.

D.B. Sutherland
McPHAR GEOPHYSICS

1st February, 1959

Drill Hole E.M. Survey - 63R, Rosebery

Hole No. 63R at Rosebery was used for a demonstration of the Drill Hole Electromagnetic System. The surveying was done on 18th January.

Hole Wander Error

The dip of hole 63R varies from vertical at the surface to 50 degrees at 1700 feet. With the drill hole system both lateral displacement and rotation of the down-hole coil will give rise to dip angles. In some instances the effects of the displacement and rotation will tend to cancel one another so that the error from the flattening of the hole is minimized. This is the case with hole 63R.

The survey data of the hole shows that the major component of the dip is in the E-W plane and consequently errors have been calculated only for Position No. 1. The calculations were made graphically from Cross Section 900S, and, since the errors were small and almost constant, only 6 points were determined. Between 0 and 1400 feet the plot of dip angles for Position No. 1 and the Hole Wander Error are almost identical and the subtraction of the error curve was not considered necessary.

Correlation

Except for small constant dip angles the curves for both Position No. 1 and No. 2 show little variation between 0 and 1200 feet. Below this point the dip angles are significant.

Position No. 2

The largest dip angles were obtained in this orientation which shows that the majority of the conductive asymmetry is about an E-W axis. The curve indicates that a conductive structure intersects the hole near 1600 feet. This depth corresponds closely with the 12 ft. and 23 ft. intersections of massive sulphides consisting of pyrite, pyrrhotite and ore.

The 400' build up of North angles has been interpreted as being due to an extensive sheet, which has a greater area to the north of the hole. However, similar results could be obtained from a uniform sheet extending equally to the north and south but dipping southerly. Model work has shown that this duality of interpretation cannot be resolved from a single set of transmitter locations.

The noise level at null is in indication of the relative amount of out-of-phase present. The marked increase in this level below 1500 feet suggests that the conductivity of the conductor is only moderate. Because of the proximity of power lines and the consequent fluctuations of noise level these measurements are somewhat unreliable.

The lack of pronounced variations between 1500 and 1600 feet suggests that the sulphides intersected in this area are due to less important subsidiary conductors.

It is interesting to note that a crossover was not obtained on the 1600 ft. band and that an increase in dip angle was found at 1650 feet. This has been taken to indicate that the effective centre of the main conductor to the north is located below the 1600 ft. level. However, it should be noted that measurements in this vicinity were difficult to take due to the high noise level and they may be subject to some error.

Position No. 1

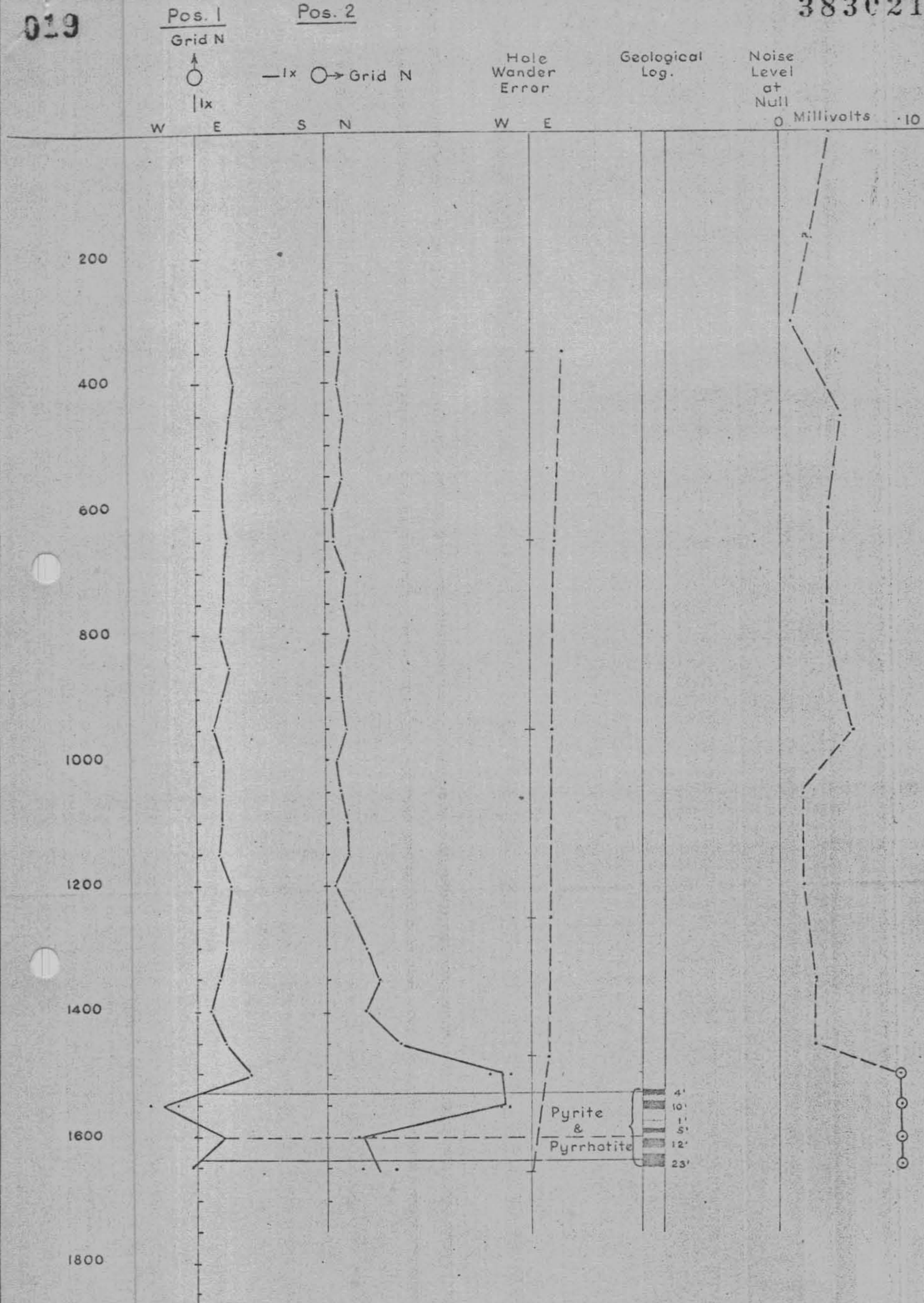
Two crossovers are evident on this curve. The first, near 1525 feet, corresponds closely with the 4 ft. intersection of massive pyrite and pyrrhotite. The lack of build up shows that this conductor has a limited extent. The East dip angles suggest that it extends furthest in this direction.

The second crossover correlates with the largest sulphide intersection and the curve shows that there is some asymmetry about a N-S axis in the immediate vicinity of the hole.

Perhaps the most significant feature of the curve in Position No. 1 is the absence of large West dip angles, this negates the existence of continuous stringers of mineralisation from hole 43R to the east of 63R. It does not, however, eliminate the possibility that a sizeable lens of massive sulphides is located between 43R and 63R (i.e. up-dip from, and not intersecting, 63R). A conductor in this position is very poorly coupled to the primary field and could remain undetected. To check this possibility it would be necessary to either re-survey 63R using a transmitter location near the collar of 43R or to re-survey 43R itself.

D.B. SUTHERLAND
McPHAR GEOPHYSICS

1st February, 1959.



D. D. Hole 63 R Rosebery

Hor. 200 ft. to 1 inch
Vert. 20° to 1 inch

5 cm