1984/79. VLF-EM trial investigation

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Abstract

Trial investigations with the CRONE RADEM VLF-EM instrument showed that it could be used in Tasmania with NWC and Hawaii as transmitting sources. It appears to be a useful ground EM tool for Tasmanian mineral exploration and may also have application in the search for groundwater.

INTRODUCTION

A CRONE VLF-EM instrument was loaned to the Department of Mines by Amoco Minerals and was used primarily to gain practical field experience with the VLF method. Trial investigations were carried out while the equipment was available. Field work with the instrument was carried out at various times by R.G. Richardson and J.W. Hudspeth, J.W. Hudspeth, or R.C. Donaldson and J.W. Hudspeth. The major investigation undertaken was VLF profiling/mapping on the Luina Exempt Area, which is being explored for economic ore deposits by P.L.F. Collins.

INITIAL EQUIPMENT TRIALS

Following receipt of the CRONE RADEM (VLF-EM) the instrument was tried out near Clifton at a spot which was flat and suitably far away from power lines and radio transmitters. NWC (North West Cape) was detected and the equipment appeared to be working satisfactorily. An abandoned car had no discernable effect on the signal and it is assumed that the car's dimensions were too small compared with the wavelength of the signal.

The CRONE RADEM was then tried out in the farmed hills south-east of Hamilton, using NWC. The single traverse was foot paced. A wire fence was crossed at roughly 90° and produced a pronounced sharp anomaly (fig. 1). Apparently significant non-zero dips occurred throughout much of the traverse and it was wondered what effect, if any, topography might have on the signal. The instrument was also read at the site of a Department of Mines borehole near Tunbridge where the topography was somewhat similar in relief to that at Hamilton (the Hamilton traverse was on dolerite, the Tunbridge borehole was in Permian surrounded by dolerite). NWC was received at zero dip. At the Tunbridge site it was also possible to detect the signal from Hawaii (H).

The CRONE RADEM was read near several different high voltage transmission lines in order to assess the distance required to be maintained away from transmission lines in order to avoid interference. The effect of the transmission lines on the readings is extreme at very close distances, but generally 100 m may be considered a safe working distance (transmission line effects may be insignificant at closer distances, possibly even as close as 50 m but it would be up to the operator to establish this for the particular area in question if it were necessary to work as close to the lines as possible).

In order to further examine the possibility of topography (and particularly dolerite topography) having an effect on the VLF signal, the CRONE RADEM was taken up Mount Wellington. At the top of a grassy bank near the picnic shelter at the Chimney Pot Hill road turnoff the dip angle was zero but was 20° east at the bottom of the bank. However, a fence, a power line and the picnic facilities were close by and so this result may

have nothing to do with bank topography. At The Springs area the dip was zero (away from obvious and suspected cultural influences), even right on the edge of a cliff. The rock type at The Springs is Triassic sandstone. No significant dips were recorded in the vicinity of the Organ Pipes; even right at their base the dip reading was almost zero. Again at the top of Mount Wellington and to the west of the TV towers the dip was effectively zero. A water pipe near the car park at the "Pinnacle" was sharply detected using NWC and is also thought to have influenced H (the signal was, however, very weak). In a small valley in dolerite near Big Bend, anomalous dips (weakening towards the Pinnacle and also somewhat towards Mount Arthur) were recorded. It was concluded from these tests that it is unlikely that topography has any noticeable effect on the RADEM detected signal but that some anomalies are due to sources which also have topographic expression. This is probably the case with the "Big Bend Anomaly". I suggest that this anomaly may be due to a more conductive corridor within the dolerite - the probable geology of this corridor being water and dolerite weathering products within a fault zone or master joint.

ARTHUR DAM ANOMALY

Geochemical investigations by P.L.F. Collins of the Arthur Dam Anomaly in the Luina Exempt Area had revealed zones having relatively high soil concentrations of particular metals. The CRONE RADEM was read along the cut lines 100N, 00N, 100S, 200S and 300S but 200N and 300N were not read because of their proximity to overhead transmission lines. Hawaii was the transmitting station used (because readings were commenced early in the morning when rapid drift might be expected from NWC - geological strike is N-S and so there was little to choose between H and NWC for orientation). The signal strength from Hawaii was felt to be adequate throughout the morning but the signal drifted in the early afternoon as the transmitting station fell under the influence of the sunset zone. Reading along 300S was continued but these readings should be assigned a lower reliability than those for the rest of the survey (apart from readings on lines 00N and 100N within 70 m of the transmission lines - these readings should be totally discounted).

P.L.F. Collins made available a base map with lines 300N to 100S plotted (but not 200S and 300S). The CRONE RADEM dip angles and maximum horizontal field strengths were plotted and contoured on these base maps (figs 2 and 3). The maps showed good qualitative correlation with the soil sample concentration maps for some metals. However, the geochemical maps are in the process of being altered to incorporate further sampling results and the appearance of some of the maps may change. Discussion of the VLF results will be reported when Collins has completed the geological/ geochemical investigation of the Arthur Dam Anomaly.

HAMILTON ANOMALY

A CRONE RADEM traverse was carried out in the paddock east of the Lyell Highway/Thousand Acre Lane to see if the shallow gully being investigated for groundwater produced any response. The rock type is dolerite. The traverse was paced, commenced near Thousand Acre Lane about 200 m from its junction with the Lyell Highway and about 20 m south-east of the roadside fence, and headed approximately south-east across the shallow dry gully and up the narrow crested hill. There was no anomaly directly associated with the gully but a significant anomaly was detected on the lower slope of the hill (see fig. 4). There was no anomaly detected anywhere else on the traverse, which terminated on the crest of the hill near the edge of a very steep descent down the other side.

The area was revisited to further investigate the anomaly. The anomaly was relocated and a rough grid measured out. Four traverses were run approximately perpendicular to the guessed strike of the anomaly. Three traverses intersected the anomaly and the fourth did not (which is to be expected having established the strike direction). The results of the four traverses are shown plotted with their axes located to represent correct relative positions of the traverses (fig. 5).

The source of the anomaly is not known. It may possibly be a buried wire (*e.g.* cable or old fence) or if it is geological it might be a fracture (fault or master joint) containing weathered dolerite and having a greater moisture content than the surrounding dolerite. The CRONE RADEM had to be returned before further investigation could be carried out. It is proposed to further pursue the possibility of using the CRONE RADEM as an aid to locating fractures having groundwater potential, if and when the opportunity arises.

NWC was the transmitting station used for all Hamilton traverses.

CONCLUSIONS

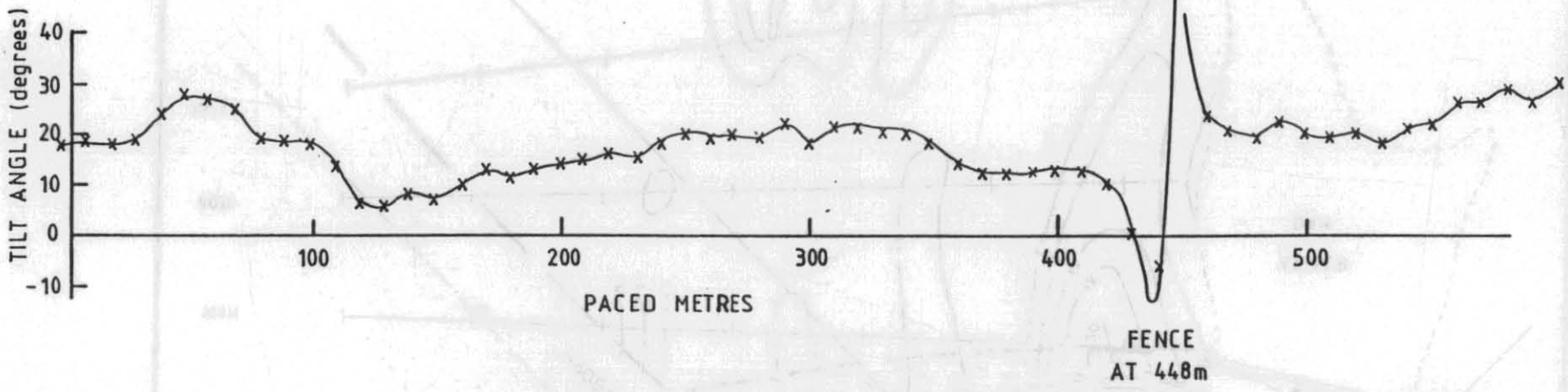
In conclusion, the CRONE RADEM is a fast, cheap, ground based EM method with potential for detecting subsurface zones of anomalous conductivity. It does not appear to be directly affected by topography and may have some use in groundwater investigation in addition to its usual role in metallic mineral exploration.

However, Tasmania's geographical location will often prevent the full potential of the VLF method being realised, owing to the paucity and remoteness of usable transmitting stations.

ACKNOWLEDGEMENT

Amoco Minerals is thanked for the loan of the instrument.

[5 December 1984]



HAMILTON CRONE RADEM-VLF

(OFF HOLLOW TREE ROAD)

J. HUDSPETH DEC 1984

Figure 1.

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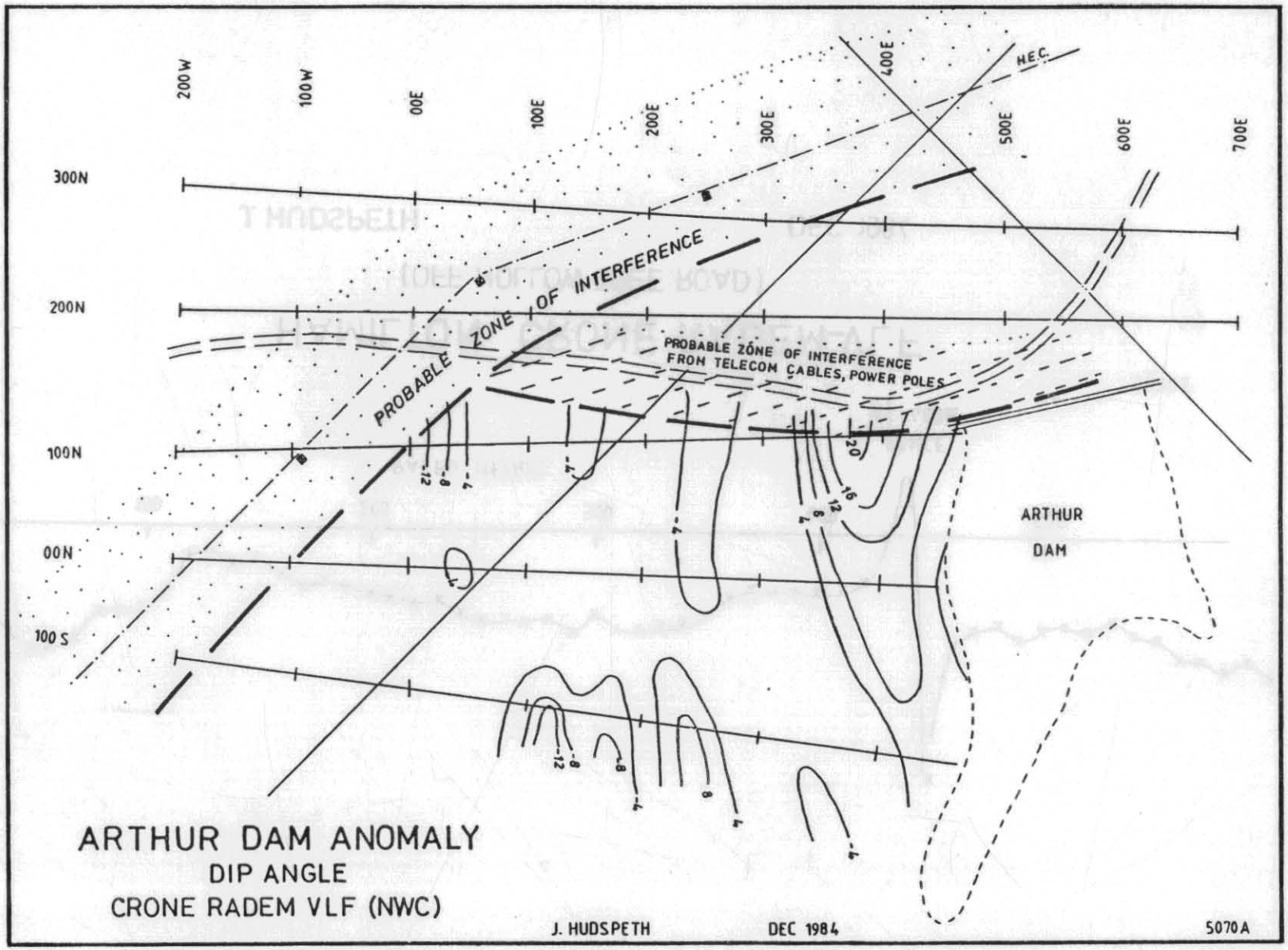

5 cm
200 W
100 W
00E
100E
200E
300E
400E
500E
600E
700E
H.E.C.
300N
200N
100N
00N
100 S
PROBABLE ZONE OF INTERFERENCE
PROBABLE ZONE OF INTERFERENCE FROM TELECOM CABLES, POWER POLES
ARTHUR DAM
ARTHUR DAM ANOMALY
DIP ANGLE
CRONE RADEM VLF (NWC)
J. HUDSPETH
DEC 1984
5070A

Figure 2.

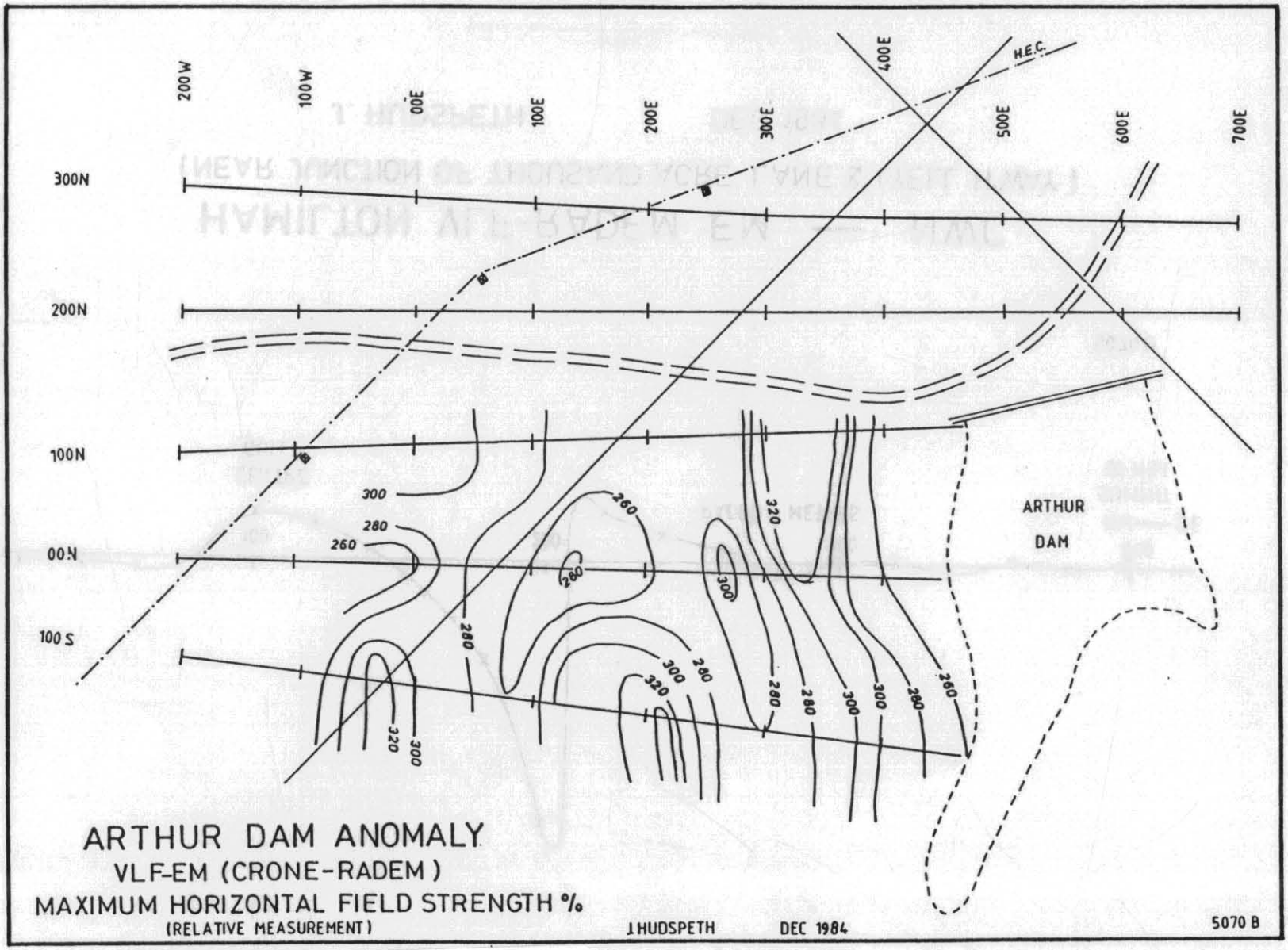
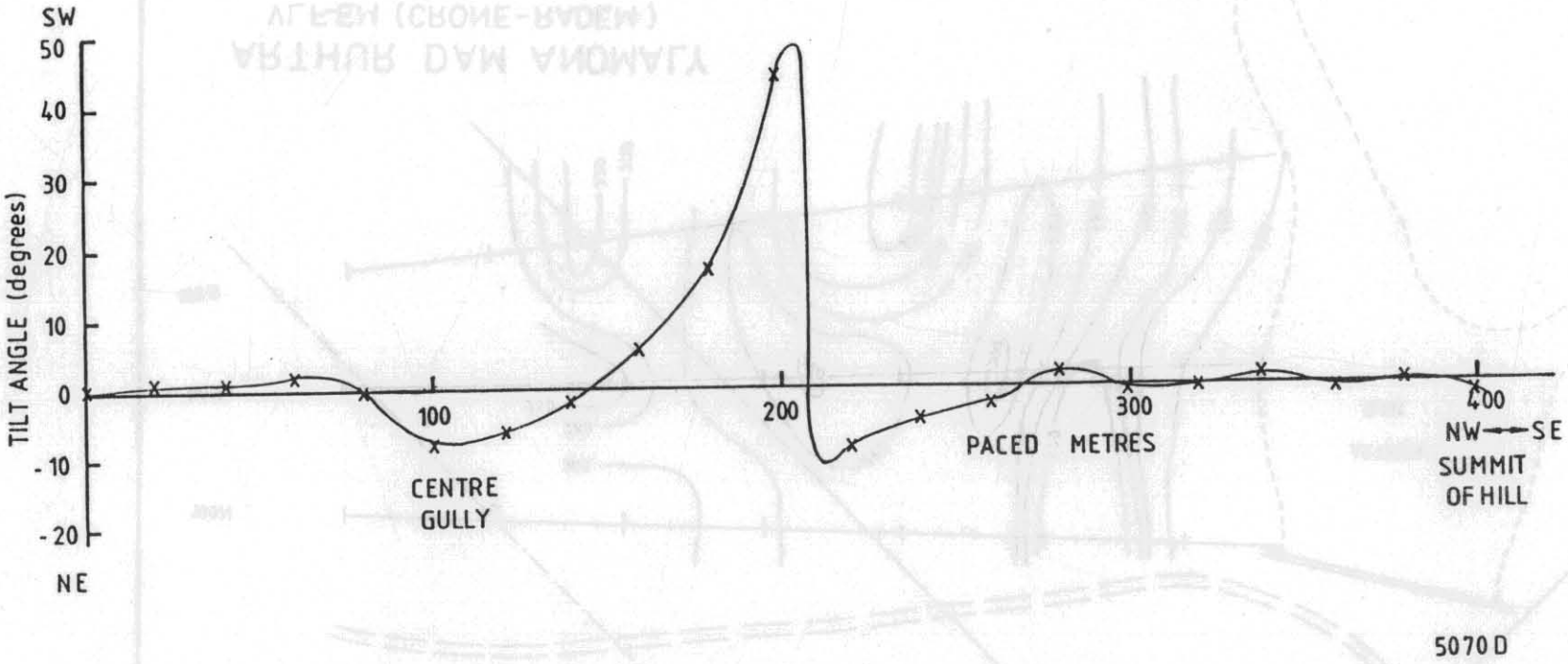

200 W
100 W
0E
100E
200E
300E
400E
500E
600E
700E
H.E.C.
300N
200N
100N
00N
100 S
300
280
260
320
ARTHUR
DAM
ARTHUR DAM ANOMALY
VLF-EM (CRONE-RADEM)
MAXIMUM HORIZONTAL FIELD STRENGTH %
(RELATIVE MEASUREMENT)
J HUDSPETH
DEC 1984
5070 B
5 cm

Figure 3.



HAMILTON VLF-RADEM EM — NWC

(NEAR JUNCTION OF THOUSAND ACRE LANE & LYELL H'WAY)

J. HUDSPETH DEC 1984

5 cm

Figure 4.

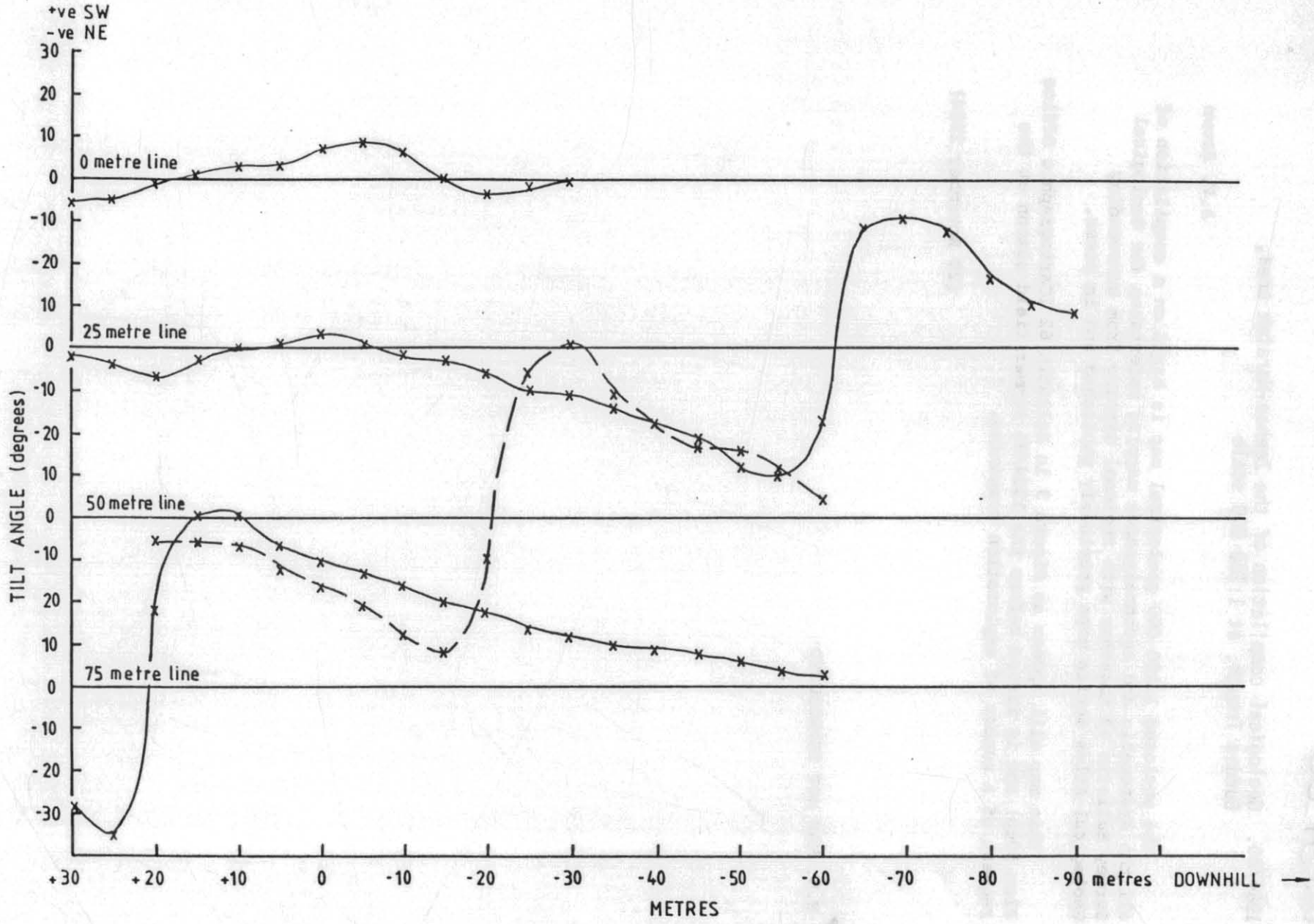


Figure 5. *Hamilton anomaly. Radem-VLF.*

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