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A GEOCHEMICAL ANOMALY WEST OF

MARY KATHLEEN, QUEENSLAND

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SUMMARY

The results of a soil and stream-sediment sampling program undertaken during 1973 are presented herein. A substantial copper anomaly (with soil values ranging up to 950 ppm) lies about 12 km WNW of Mary Kathleen. The anomaly is located within the Corella Formation, which is known elsewhere to contain copper mineralization; its apparent association with the intersection of two faults is also encouraging from an economic viewpoint. A drill hole in the area encountered disseminated sulphides, but it is doubtful that the most favourable zone for mineralization was intersected, and further drilling is recommended.

INTRODUCTION

A small 'gossan' discovered in 1972 during the course of geological mapping near Mary Kathleen was considered sufficiently interesting to warrant further study. Detailed geological mapping and geophysical and geochemical surveys were carried out in the area of interest during the 1973 field season. Later in the year BMR Cloncurry No. 8 was drilled. The results of the geochemical work are presented here.

Location

The study area lies about 12 km WNW of Mary Kathleen and about 3 km north of the North Western Highway (Fig. 1). The road to Mount Carrington mines passes close by.

Physiography and climate

Relief in the area is quite pronounced, with steep quartzite ridges prominent in the central and northeastern parts.

The climate may be described as semi-arid monsoonal tropical with a well defined wet season. The average annual rainfall is about 380 mm (15 inches). Rain is almost entirely confined to the period November to April, with January and February the wettest months; as a consequence most streams are dry during winter. The average annual maximum and minimum temperatures are 32°C and 17°C respectively; December is the hottest month and July the coldest.

Geology

The geology of the Mary Kathleen region has been described in detail by Derrick et al. (1974). There are two formations in the area sampled - the Corella Formation and the overlying Deighton Quartzite (Fig.1). Both are Proterozoic in age.

The Corella Formation crops out over most of the area; it consists largely of fine-grained calcareous sediments although quartzites are prominent in places. These rocks are exposed on the western limb of a shallow north-plunging major syncline; dips are generally about 60° to the east. Structurally the area is dominated by two intersecting faults: one strikes NNW-SSE, and the other, a strike slip fault, trends NNE-SSW. Several 'gossanous' zones are associated with the fine-grained sediments of the Corella Formation: some are concordant with the surrounding strata, others are cross-cutting. All are manganese-rich and consequently dark in colour; sericitic alteration is common but no boxworks have been observed.

The Deighton Quartzite crops out only in the extreme northeast of the area.

SAMPLING AND ANALYTICAL METHODS

Soils

Soil sampling was carried out on a rectilinear grid 2200 m long by 780 m wide. Sample spacing was generally 200 m x 60 m but a closer spacing of 100 m x 30 m was used in the area of greatest interest. Soils were taken from a depth of 20 cm using a miner's pick. At each site about 200 g of material were collected, and details of the soil colour, underlying lithology, etc., were noted. A number of pits were dug, and samples were taken at various depths to study the vertical distribution of selected elements within the soil profile.

Stream sediments

Sieving of stream sediments was carried out on site using plastic sieves fitted with nylon bolting cloth. At each locality three size fractions were sampled: - 75 microns (22 mesh BSS), - 180 microns (85 mesh BSS) and - 75 microns (200 mesh BSS). More than 50 g of sample was collected at each site. Field data noted included stream width, sediment texture, position in stream bed from which the sample was taken, bank type, and surrounding lithology.

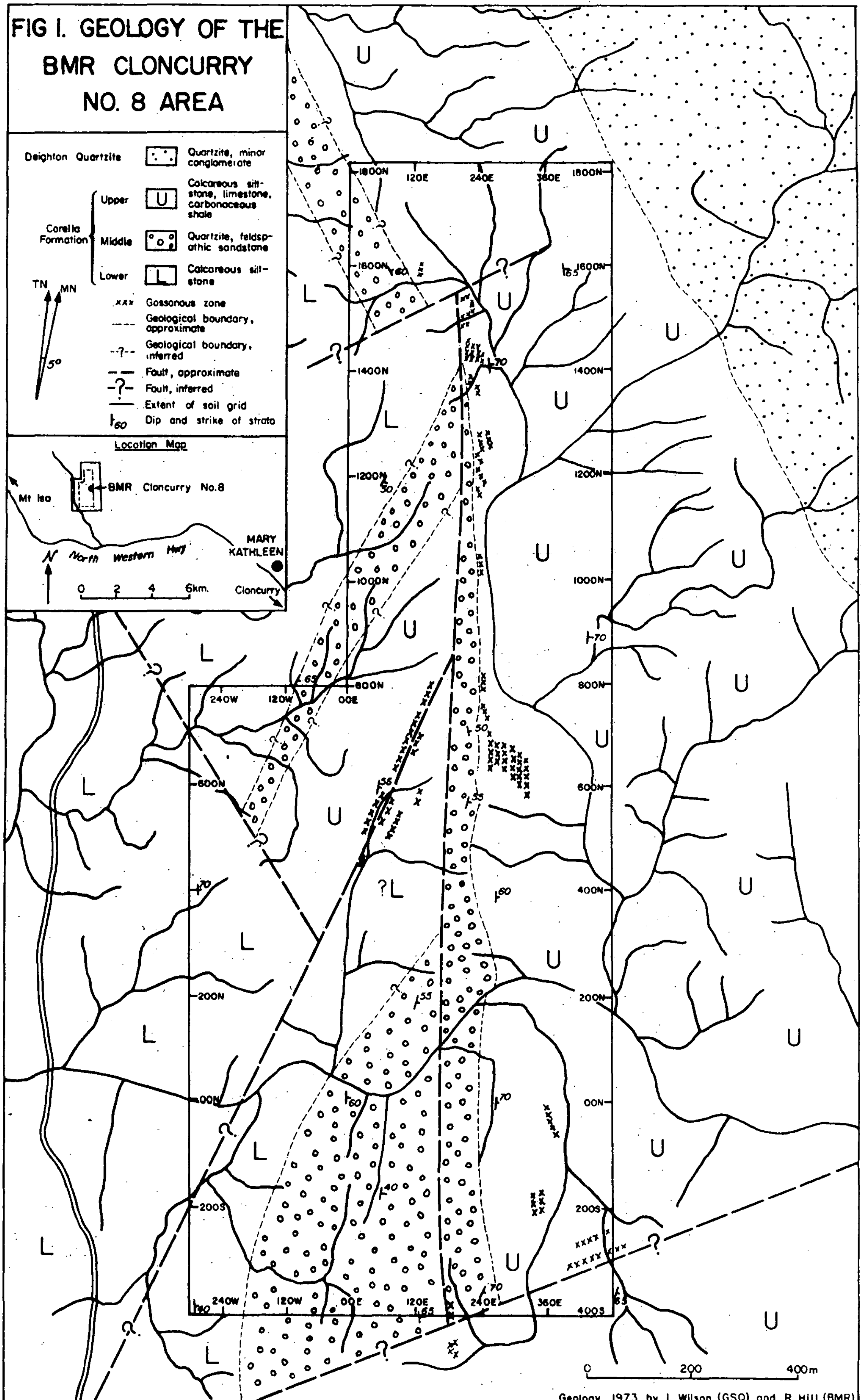

FIG I. GEOLOGY OF THE BMR CLONCURRY NO. 8 AREA
Deighton Quartzite
Quartzite, minor conglomerate
Corella Formation
Upper
Calcareous siltstone, limestone, carbonaceous shale
Middle
Quartzite, feldspathic sandstone
Lower
Calcareous siltstone
TN
MN
5°
Gossanous zone
Geological boundary, approximate
Geological boundary, inferred
Fault, approximate
Fault, inferred
Extent of soil grid
Dip and strike of strata
Location Map
Mt Isa
BMR Cloncurry No.8
MARY KATHLEEN
North Western Hwy
Cloncurry
0 2 4 6km.
0 200 400m
Geology 1973 by I. Wilson (GSQ) and R. Hill (BMR)
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Analysis of samples

A total of 228 soils and 365 stream sediments was submitted to AMDEL for additional sample preparation and analysis. Soils were dried and sieved to -180 microns; the coarsest stream-sediment samples required pulverizing. Analysis for Co, Cu, Fe, Mn, Ni, Pb, and Zn was carried out by atomic absorption spectrophotometry following a $HCl/HClO_4$ digestion; these elements were chosen after a selection of samples had been examined qualitatively by optical emission spectrography in the BMR laboratories.

DISCUSSION OF RESULTS

The results for Co, Fe, Mn, Ni, Pb, and Zn proved to be of little interest.

Cobalt ranged from less than the detection limit of 5 ppm to 42 ppm in soils, and from less than 5 ppm to 35 ppm in stream sediments.

Iron contents of soils lay between 1.0% and 7.2%, and of stream sediments between 0.7% and 16.0%.

Manganese varied from 55 ppm to 4250 ppm in soils, and from 50 ppm to 2.1% in stream sediments.

Nickel values observed in soils varied from less than 5 ppm to 70 ppm, and in sediments from 5 ppm to 40 ppm.

Most lead values were less than the detection limit of 5 ppm with maxima of 10 ppm in soils and 20 ppm in stream sediments.

Zinc varied from 8 ppm to 160 ppm in soils, and 5 ppm to 95 ppm in stream sediments. No anomalies of even minor significance were located.

Of the elements determined, only copper showed any anomaly, with high values occurring in both soils and stream sediments. For this reason, and because there was no correlation of Cu with any of the elements mentioned above, the following discussion is restricted to copper results only.

Soils

Figure 2A shows as a histogram the distribution of copper in the soils of the area. There is a slight tendency* for lower copper values in soils overlying the quartzite unit of the Corella Formation , but this trend is not sufficiently pronounced for two background populations to appear in the distribution. A single value can be quite safely used, therefore, to define anomalous levels, and underlying lithology need not be taken into account. The histogram is positively skewed, implying that the background population may have lognormal affinities.

Tennant & White (1959) first pointed out the advantages of cumulative frequency plots on probability paper for the population analysis of geochemical data. The use of such plots has been widespread in the subsequent geochemical literature, e.g. Williams (1967), Lepeltier (1969), Kroon & de Grys (1970), Wilding et al. (1970), Bolviken (1971), and Woodsworth (1972).

A probability cumulative frequency diagram for copper in the soil samples is shown in Figure 2B. As mentioned above, the histogram suggests that the background population is roughly lognormal in character, and so logarithmic probability paper has been used in the construction of the plot. Low copper values lie fairly close to a straight line indicating that the background population is reasonably well described by a Gaussian lognormal distribution. Above a level of 60 ppm copper there is an abrupt change in the slope of the curve, implying a deviation from typical background values. In other words, 60 ppm is the level at which a second (anomalous) population begins to make significant contributions to the total copper distribution.

* Of the samples containing less than 10 ppm copper, 65% overlay quartzite and 35% overlay calcareous sediments.

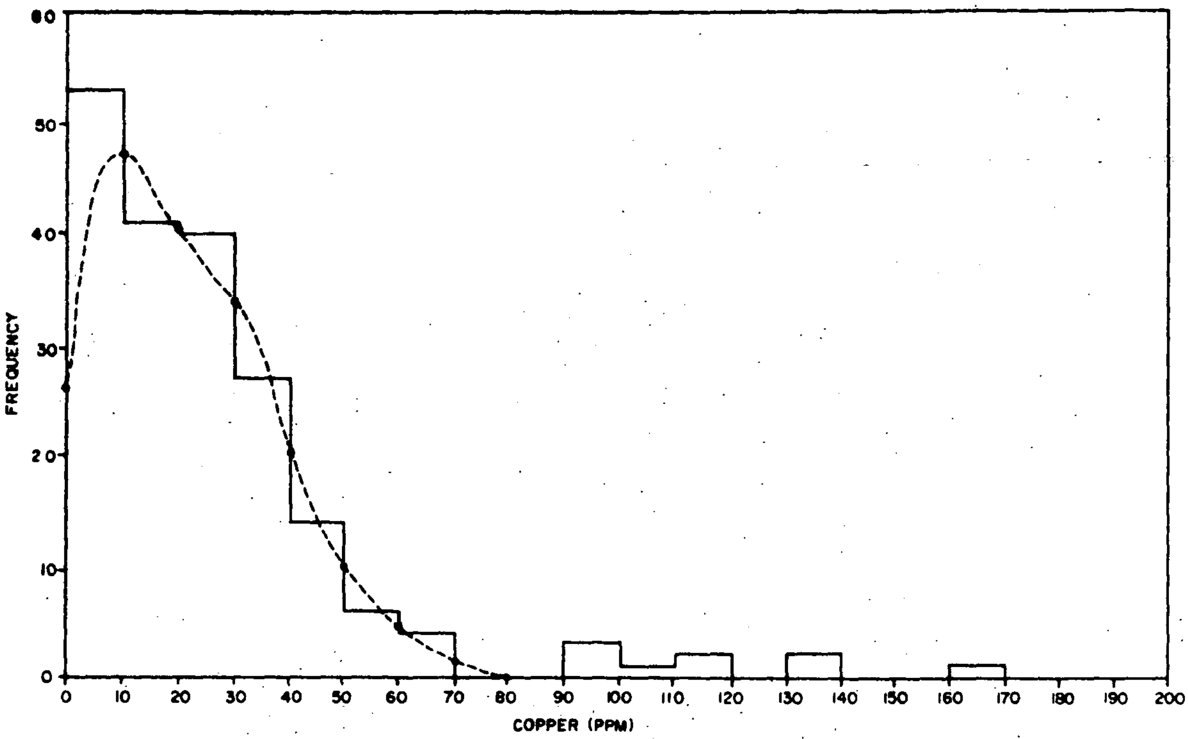

Fig 2A: Histogram showing the distribution of copper in soils. The curve was fitted using the moving average technique.

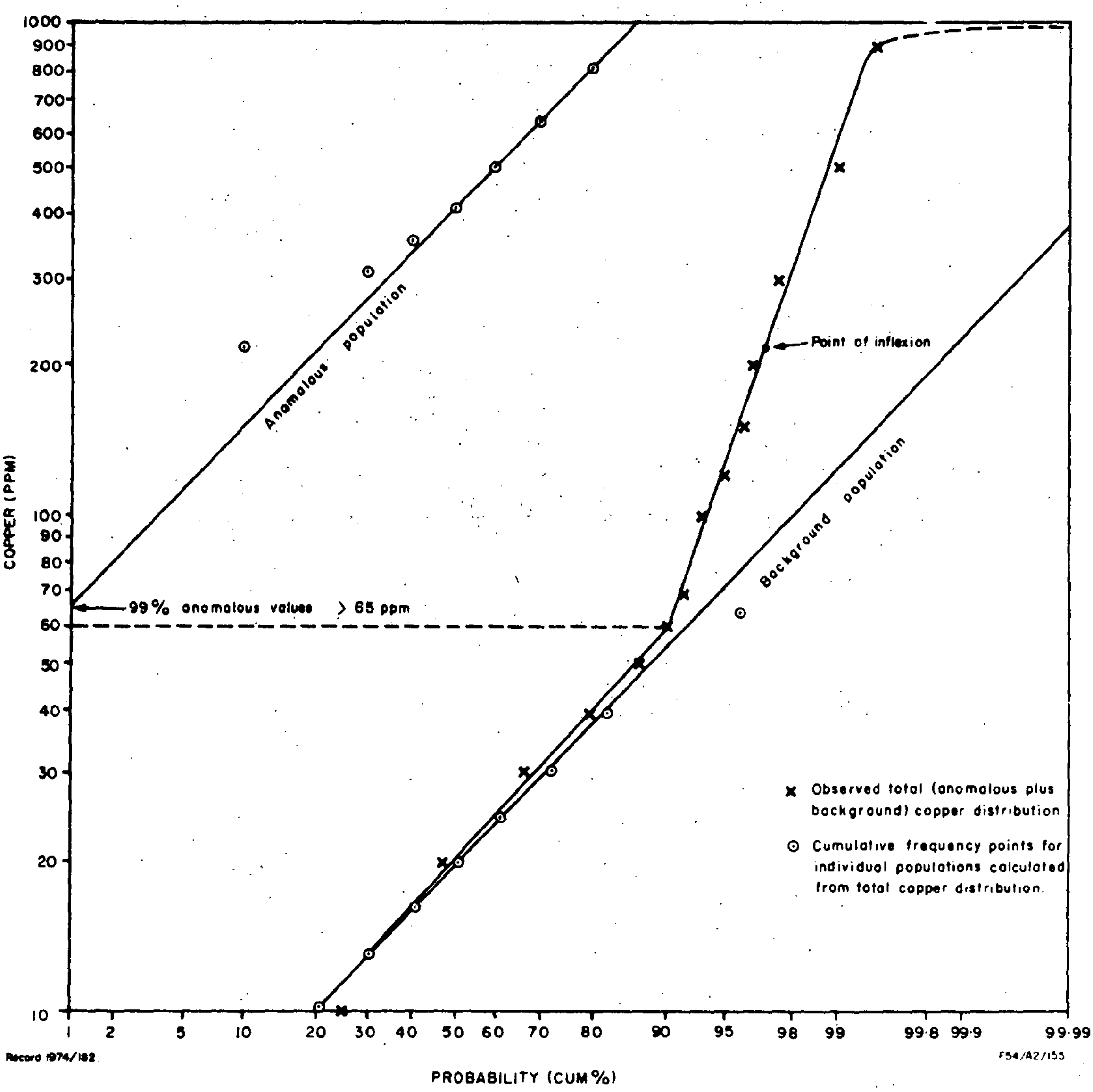

Fig 2B: Logarithmic probability plot for copper in soils. Individual populations have been extracted mathematically using the method of Sinclair (1974)

It is reasonable, then, to define this value (60 ppm copper) as distinguishing anomalous from background samples.

Sinclair (1974) described a mathematical partitioning method by which individual populations may be extracted from polymodal distributions. Using his technique (Fig. 2B) it can be shown that 99% of anomalous samples have copper contents in excess of 65 ppm. Hence the results obtained by simply estimating anomalous levels from the break in slope and using the more elaborate partitioning procedure are very similar. The simpler method is therefore considered adequate for the future purposes of this discussion.

Figure 3 shows areas where the copper content of the soil exceeds 60 ppm. The most interesting anomalous zone (No. 1) lies near the central part of the soil grid - it is about 600 m in length and up to 100 m wide. An ironstone sample taken from this zone contained 2900 ppm Cu. A smaller anomaly (No. 2) lies a few hundred metres to the east - this is associated with the original 'gossan' discovery referred to in the Introduction. Other less extensive anomalous areas (Nos 3-8) lie mainly to the south. Anomalies 6 and 7 are probably related to major faults, whereas the other 'highs' may be associated with smaller shears. A tiny malachite outcrop occurs near Anomaly No. 8.

Mineralized soil profiles (Fig. 4) indicate a general increase in copper with depth (Profiles A,B,C), although one (C) shows some surface enrichment. In view of this, auger sampling of weathered bedrock is suggested for future geochemical work in the area. A near-surface sample at a point such as A might not indicate that the underlying bedrock contains anomalous copper.

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Stream sediments

As previously noted three stream-sediment size fractions (-710 microns, -180 microns, -75 microns) were collected at each sample site. Histograms of copper distributions within each of the three fractions are shown in Figure 5. In contrast to the soils the stream-sediment histograms do not show any obvious lognormal affinities, and so cumulative frequency plots have been constructed on both arithmetic and logarithmic probability paper.

The definition of anomalous values for the -710 microns fraction is relatively easy. The histogram for this fraction suggests that a normal distribution is a reasonable approximation to the observed background copper population. This is confirmed by the fact that the arithmetic probability diagram (Fig. 6) follows a straight line for low copper values, while the equivalent part of the logarithmic probability graph (Fig. 7) is curved. A sharp break in the arithmetic plot shows the lower anomaly limit to be 50 ppm copper.

The choice of what constitutes an anomaly for the -180 and -75 micron fractions is more subjective. The difficulty arises because each arithmetic probability graph can be interpreted with equal validity as a pair of intersecting straight lines or as a single curved line. If the rectilinear interpretation is adopted, anomalous samples are defined as those containing more than 40 ppm and 50 ppm copper respectively. These values appear erroneously low, however, as the histograms (Fig. 5) indicate background levels to be higher in the finer fractions than in the -710 micron fraction. Therefore, it is considered preferable to interpret the arithmetic probability diagrams as curvilinear and use the straight-lined logarithmic plots (Fig. 7) to define anomalous levels. This procedure suggests that anomalies can be recognized by copper contents of greater than 70 ppm in the -180 micron fraction and greater than 80 ppm in the -75 micron fraction.

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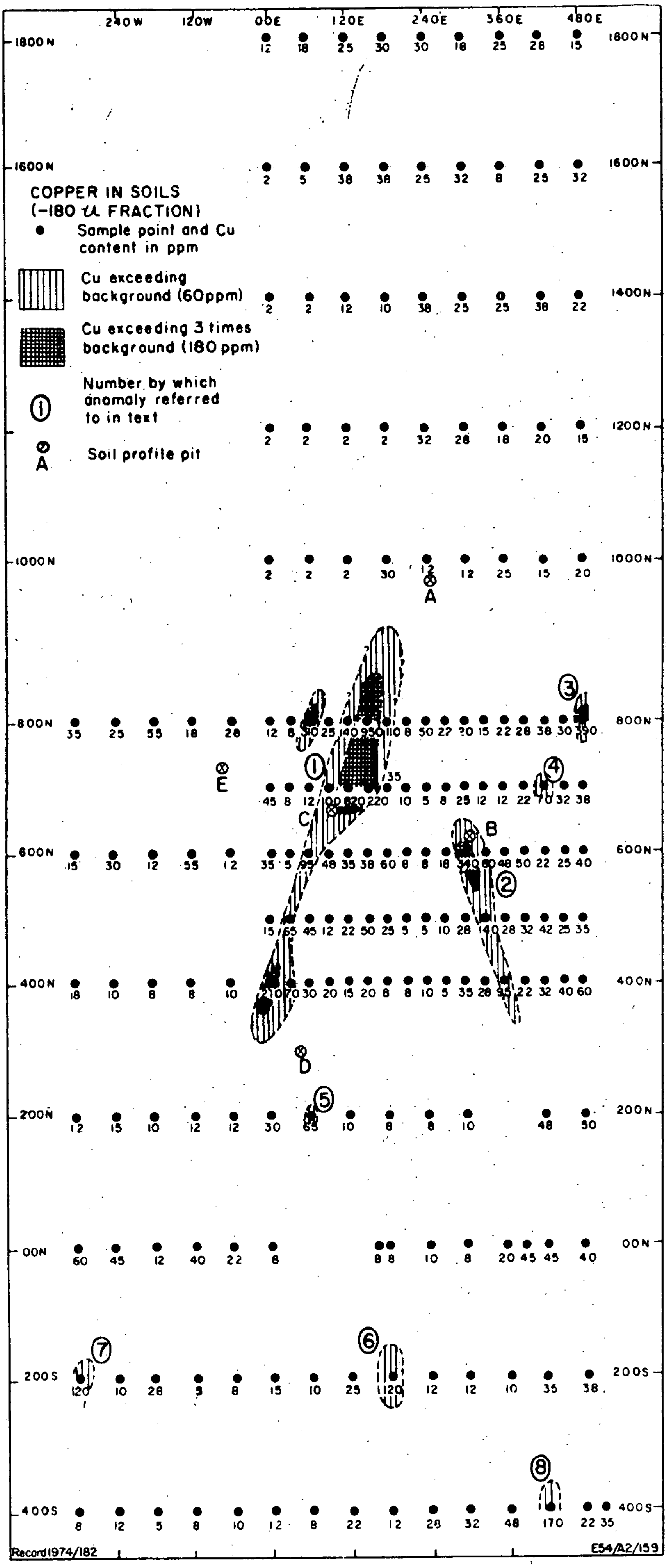

Fig 3: Results of soil sampling in the BMR Cloncurry No. 8 area. Grid co-ordinates are in metres.

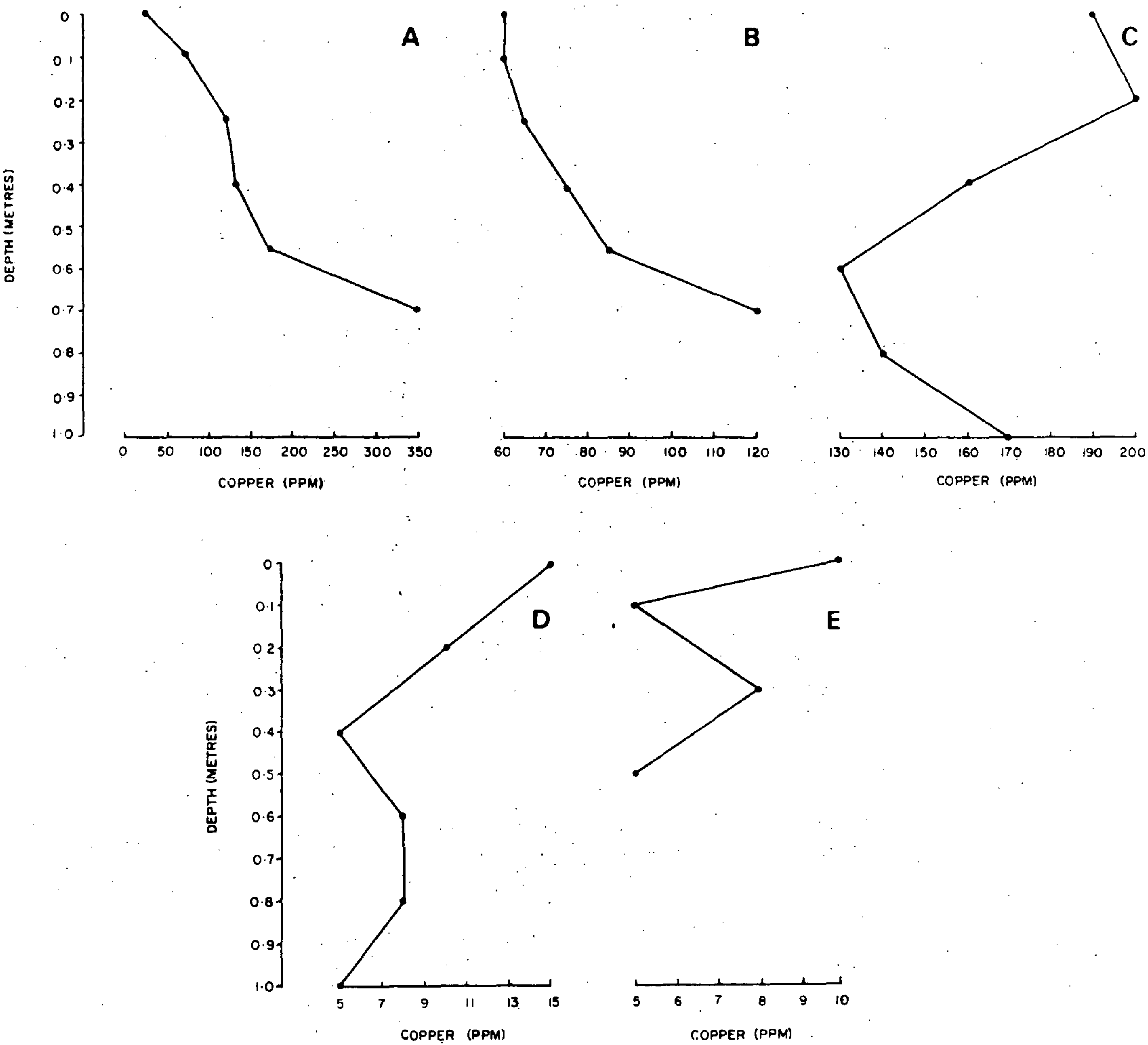

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Fig 4. Vertical distribution of copper in several soil profiles. Profile locations are shown in Fig 3

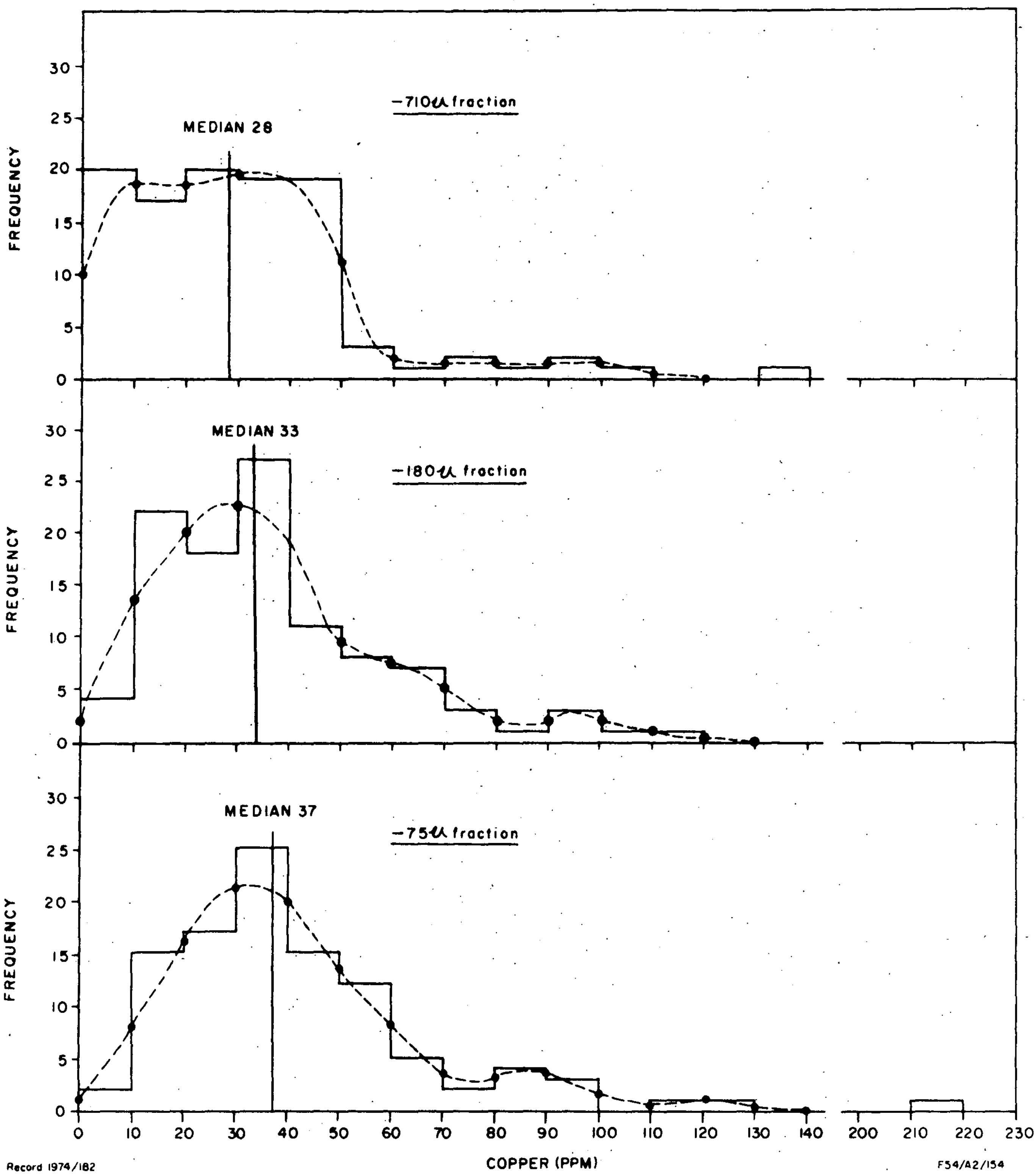

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Fig.5 Histograms showing the distribution of copper in stream sediments. The median increases with decreasing grainsize, suggesting higher background levels in the finer fractions. The median is considered the best measure of the central tendency of the background populations because the mean is more likely to be affected by the sporadic high values in each distribution, and the mode is not always well defined.

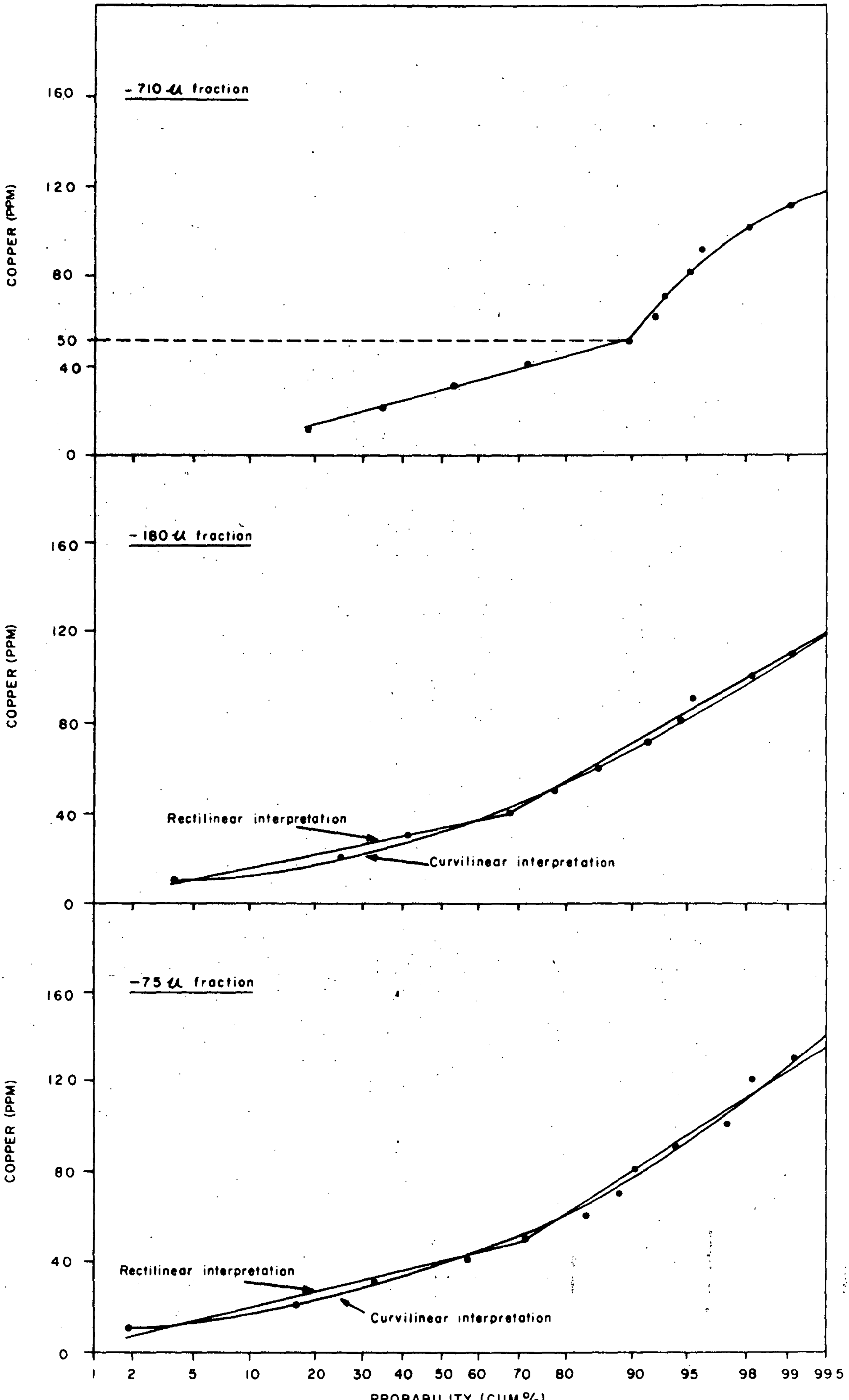

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Fig 6 Arithmetic probability plots for copper in stream sediments

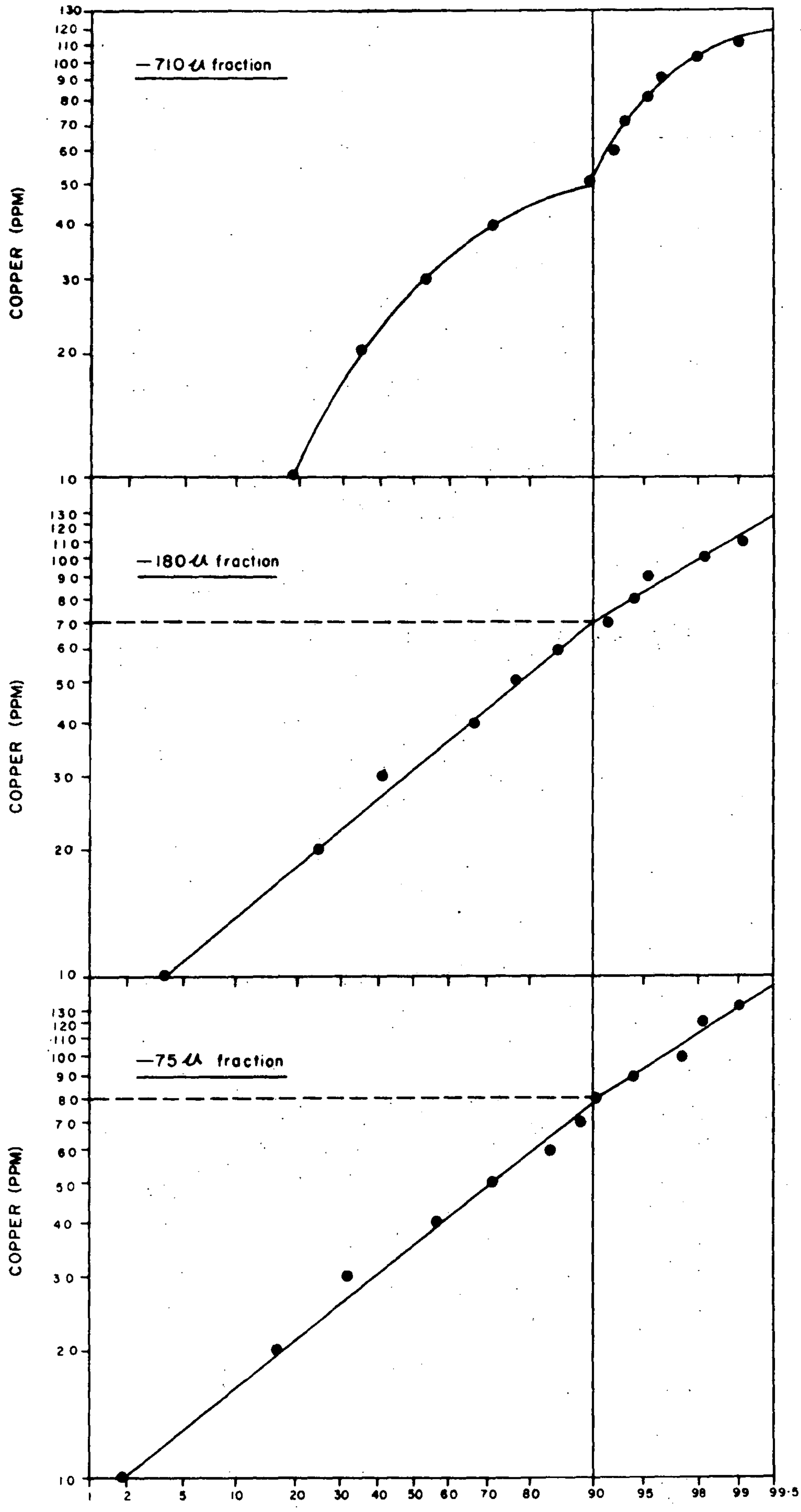

Fig.7: Logarithmic probability plots for copper in stream sediments. The break in slope for the —75 micron fraction is rather indistinct, but a fair degree of confidence can be placed in the interpretation shown, as breaks occur in the other two fractions at the same cumulative frequency (i.e. 90%)

Figure 8A,B,C show the location of anomalous stream-sediment samples. The most pronounced anomaly is associated with the largest soil 'high'. Only two significant* anomalies occur outside the soil grid - one near the southwest corner of the area (No. 9) and one in the southeast (No. 10). The first is probably due to contamination from the road to Mount Carrington mines: pieces of ore that have fallen from trucks are scattered along the roadside, and sediment samples collected downstream from the road are very high in copper (to 2550 ppm). The other anomaly (No. 10) is only weak (-710 microns, 80 ppm; -180 microns, 80 ppm; -75 microns, 65 ppm) and should, therefore, be assigned low priority for any follow-up work.

CONCLUSIONS AND RECOMMENDATIONS.

There seems little scope in the area for follow-up geochemical work apart from more detailed sampling around the main soil anomaly; augering to collect weathered bedrock samples is the method recommended. Such work could perhaps be concentrated towards the north of the anomalous zone because its extension in this direction is poorly outlined.

BMR Cloncurry No. 8 was drilled at an inclination of 60° in a westerly direction (Fig. 8). Disseminated pyrite, pyrrhotite, and chalcopyrite were encountered at various levels below 100 m, but the hole passed a long way to the south of any possible mineralization occurring down-dip from the main soil anomaly. It would appear, therefore, that the most promising zone has not been intersected. The geological environment (the intersection of two faults) is favourable for mineralization and the soil anomaly of substantial size and intensity; in addition; geophysical work (Sampath, in prep.) indicates

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* Significant anomaly is defined as one reflected in more than one size fraction.

that there are Turam, IP, and Transient EM anomalies in the area. Additional drilling is, therefore, considered warranted.

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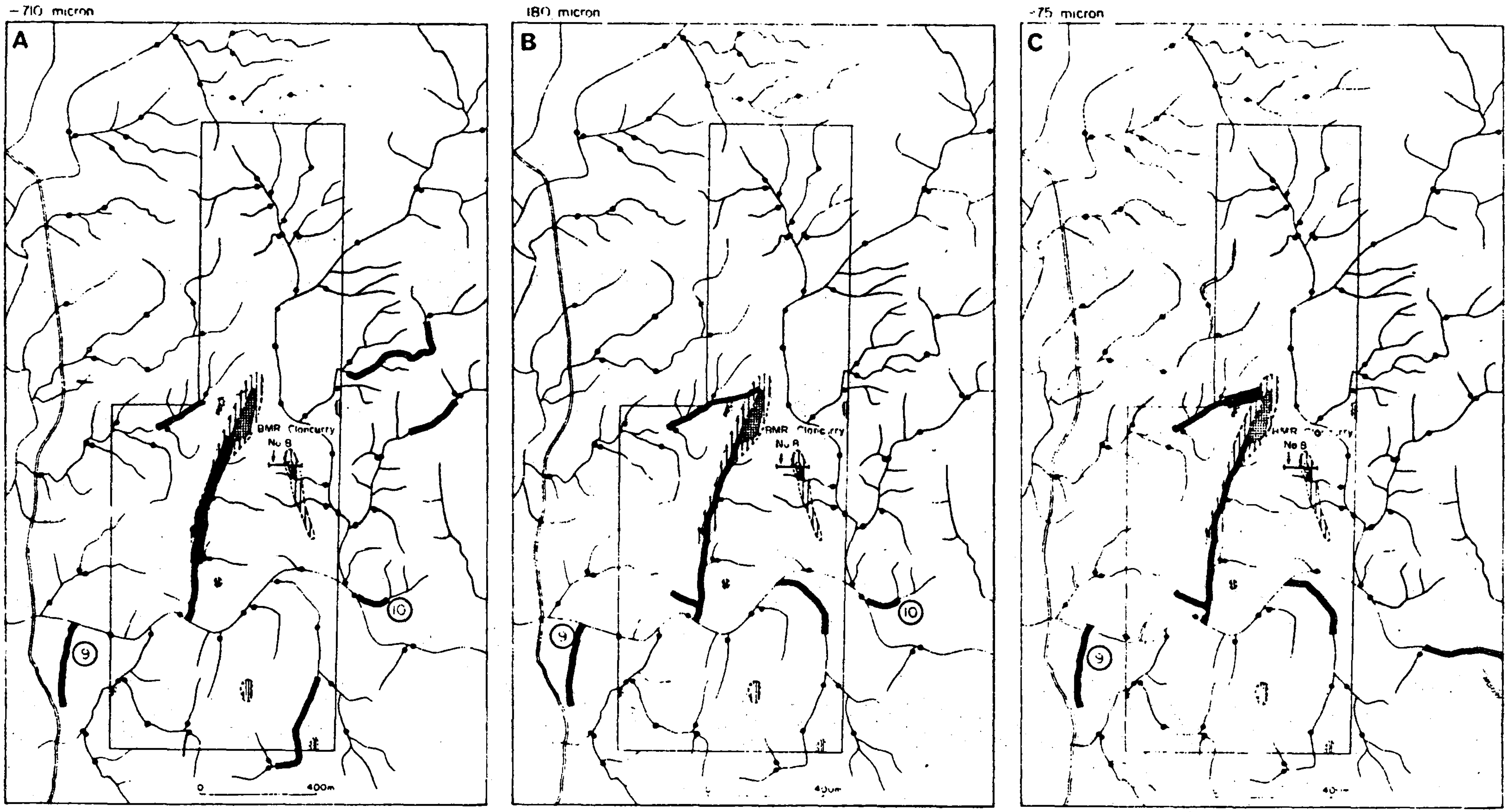

Cu exceeding background (>50 PPM)

Cu exceeding 2 times background (>100 PPM)

Cu exceeding background (>70 PPM)

Cu exceeding background (>80 PPM)

Cu exceeding 2 times background (>160 PPM)

Stream-sediment sample point

(9) Number by which anomaly referred to in text

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Figs 8A, 8B, 8C: Comparison of soil and −710 micron, −180 micron, and −75 micron stream-sediment anomalies. Contour intervals for soils are the same as those in Figure 3. The position of diamond-drill hole BMR Cloncurry No. 8 is shown.

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