M.I.M. Exploration Pty. Ltd.

MEMORANDUM

Enzyme Leach Trial Over the Walford Creek Zn-Pb Prospect

Keith Hannan
15th March 1996

IMPORTANT - 2018 April
original tables and figures missing
selected figures recovered from "overhead" film copies
schematic map added (ex-film)
field photos added (scans of photographs)

CONTENTS

Survey Costs (excludes field logistics and support)

KWH time in field	: 8 days	2540
KWH report	: 16 days	5080
Airfare and photos		700
Assays enzyme leach	US$5180	7045
Assays Total Digest		2928
Drafting and Secretarial: 2days		400
		$18693

M.I.M. Exploration Pty. Ltd.

Memorandum

From : Keith Hannan
To : Ian Willis
Date : March 15th, 1996
Subject : Walford Creek Orientation Geochemical Survey

Title : **Enzyme Leach Trial Over the Walford Creek Pb-Zn Prospect**

Conclusions

Enzyme leachable Zn in alluvial sands constitutes a geochemical anomaly that extends several hundred metres south of the Fish River Fault at the Walford Creek Pb-Zn prospect. Total zinc, by contrast, drops sharply to background levels 50 metres beyond the Fault. The anomaly appears to extend across the surface projection of an extensive pyrite lens and associated mineralisation of the Mount Les Siltstone beneath more than 70 metres of overburden.

When normalised to Mn (metal/Mn+metal), enzyme leachable Zn, Cu and V display a combined pattern similar to the unprocessed Zn data. That is, an anomaly occurs at the surface, with blind mineralisation 70m below, and extends up to 1 kilometre southward above an extensive pyrite lens of the Mount Les Siltstone. The anomaly is attributed to either horizontally- or vertically-directed hydromorphic dispersion of metals from primary mineralisation into the cover sands. There is no convincing evidence of electrochemical dispersion at Walford Creek (*c.f.*, Ernest Henry).

The enzyme leach anomaly represents a large increase in the area of explorable secondary dispersion. Undiscovered sediment-hosted Pb-Zn deposits in the Gulf region are likely to occur next to faults with a complex movement history. Therefore, hydromorphically redistributed metals may occur over extensive areas at various levels in cover materials and may be laterally offset from ore. The dispersions are easily accessed and are likely to have preserved chemical gradients. They are therefore valid targets for early-stage ground assessment in appropriate settings such as the Gulf of Carpentaria.

There is a 300m wide enzyme leach anomaly in the southwest of the survey area (Line 6900E) which should be assessed in relation to existing targets derived from geophysical data and basin reconstructions.

Introduction

Survey Rationale, Location and Geology
As part of a continuing programme of technique development for covered terrain geochemical exploration, sampling of two lines over blind parts of Walford Creek prospect mineralisation was carried out in early May 1995 to test metal responses to the enzyme leach method.

The plan, overleaf, shows the location of the survey lines relative to the Fish River Fault and the vertically projected upper pyrite lens (inferred from a TEM survey). The schematic cross section (also overleaf) shows relationships between different rock units, structures and mineralisation. Near the Fish River Fault, survey line 12900E transects strong mineralistion beneath a few metres of alluvium and about 70m of Mount Les Siltstone. The associated pyrite lens extends more than 1000 metres to the south. Survey line 6900E, on the other hand, transects only very weak mineralisation (<1 wt% combined) and a deeper and weakly pyritic horizon.

Regolith Characteristics and Sampling Methodology
The cross sections of Figures 1 and 6 summarise topographic and shallow geologic features along each survey line. Samples were taken 25m apart within a few hundred metres of the Fish River Fault, and 50m apart elsewhere.

Most of the survey was conducted on a broad plain of fine-grained, pale-coloured, quartzose alluvial sand (Plate 1a). Except for abundant grass roots, the surficial sand does not have the appearance of a true soil. A colour change is not normally observed until a depth of 25cm or more, where irregular patches of faint orange mottling is observed (Plate 1b). Locally, these mottles are centred by dark brown to redddish sooty hematite and have developed at some sample sites to harder pisoliths and pisolith clusters. Similar pisolith development was observed in our N.T. gulf country tenements and probably results from high level ground water stands during the wet season.

Samples on the alluvial flats were generally taken at the first appearance of mottling, with the assumption that it represents an oxidation-reduction interface suitable for scavenging mobile metal compounds.

In areas of outcrop (*e.g.,* Plate 2a), samples were dug from patches of colluvium, or where necessary, from large cracks and joints within the rock pavement. Generally, a stoney soil with a moderate organic content was present, and the sample was taken at the colour transition to brown or red-brown silty colluvium beneath (Plate 2b).

Most samples were sieved to -0.25mm and stored in a zip-lock plastic bag (100-200g). Damp samples were sieved to -2mm (3-400g) and resieved at the lab to -0.25mm before analysis. Sample depths, regolith characteristics, and sample sieve fraction were all recorded at each station and are reported in Tables 1-4.

Quality Assurance

The effect of sample site variation on enzyme leach and total assay responses was tested by two excavations, 2-5m apart to the same depth, every 10-20 stations (recorded in the QC column of Tables 1-4). As noted for other surveys (*e.g.,* Hannan, 1995a,b), enzyme leach responses are quite robust over areas of tens of square metres. The results of 13 site replicates for Cu and Zn are displayed in Figures 10-12 (see QA and Assay section at end of report). Only station 29400N on line 6900E shows poor replicate correspondence (Fig.12).

Given that samples were taken at a large range of depths, there was some concern that an additional source of variation had been introduced into the assay data. However, a plot of sample depth versus enzyme leach Zn for one line indicates that depth does not control the enzyme leach response at the survey scale (Fig.13).

Line 12900E

Observations

(1) *Zn:* Enzyme leach and total zinc responses in the alluvial sands south of the Fish River Fault differ markedly. Total Zn values drop sharply 50m beyond the Fault to less than 20ppm, whereas enzyme leach Zn decays from elevated values over several hundred metres before dropping to a possible background level at 31000N (see Figure 1, upper).

(2) *Cu:* The enzyme leach Cu profile is similar to that of Zn (Figure 1, middle). By contrast, total Cu values increase slightly but progressively from the south towards the Fish River Fault (refer Figure 5a for clarity). The highest total Cu values occur in samples just south of the Fault, in an area with a slightly subdued enzyme leach Cu and Zn response.

(3) *V:* The total vanadium profile is almost flat, without a discernible change across the alluvium-outcrop transition (Figure 1, lower). By contrast, enzyme leach V increases steadily in the sands south of the Fault, and there is a discernible base-level change at the alluvium-outcrop transition. Enzyme leach V abundances do not appear to respond to known or inferred faults, and are not anomalous above known mineralisation like Zn and Cu.

(4) *Normalised profiles:* Normalisation against Mn highlights the enzyme leachable Zn- and Cu-anomalous nature of the sands south of the Fish River Fault (Figure 2). Normalised V values are also emphasised in samples up to 1000m south of the Fault (Figure 2, lower). In the combined plot of Figure 3, the 800-1000m wide anomalous zone is highlighted as well as isolated peaks that may correspond to geological features; *viz.*, the 29550 peak occurs at the transition from older to younger alluvium to the south, and the outcropping subunit Pff_3 at 32250N is slightly anomalous.

(5) *Other features:* Samples betwen 29750 and 29950N have elevated halogen levels (Figure 4). The alluvium at this location is pisolite rich and corresponds to a gradual elevation drop of about 2m to younger alluvium associated with the flood plain of a large creek at 29250N. South of this transition the alluvium has progressively higher total Fe, Mn, K, Ba, and V abundances consistent with a provenance change (Figure 5b-d). Samples from this area also have unusually elevated enzyme leach Sb, Ba and Mn values, presumably also a provenance feature (Figure 4).

Interpretation

The lack of a total Zn dispersion south of the Fault indicates that clastic input to the recent sands from mineralised rocks in the vicinity of the Fish River Fault is minimal. This argument is supported by:

(a) higher levels of some lithophile elements south of the Fish River Fault that are inconsistent with mechanical derivation from the north (*e.g.*, total K and total Ba, Figure 5c,d);

(b) an opposing, abrupt decrease of other chalcophile elements across the Fault in common with total Zn (*e.g.*, total As, Figure 5b);

(c) maximum enzyme leach Zn values offset some 150m to the south of the Fault; and

(d) visible mechanical dispersion limited to pebbly ferruginous colluvium within 50-75m of the Fault.

Therefore the anomalous enzyme leach Zn pattern in the alluvial sands is not a product of lateral mechanical dispersion of primary mineralisation. Lateral hydromorphic or vertical transport of Zn from depth (hydromorphic or vapour-assisted) must be responsible.

A minor mechanically dispersed component from the north could account for the total Cu pattern south of the Fault. As noted for Zn however, *the enzyme leach and total Cu profiles diverge in detail*, suggesting independent mechanisms of dispersion.

The broadly coincident normalised Zn, Cu and V anomalies of line 12900E provide an even stronger argument against provenance control of the enzyme leach patterns. Firstly, individual Cu-Zn and V peaks from the anomalous zone do not always coincide. Secondly, the normalised metal pattern is not simply an artifact of lower Mn abundances because equally low Mn values occur in samples beyond the main anomalous zone (Figure 4c, upper).

The single station anomaly at 29550N may be related to a local wet season flooding level. Local pisolite development above creek beds and enzyme leach halogen anomalies at breaks in gentle slopes above gulley systems and creeks were also observed in similar surveys at HYC and Lorella (to be reported).

Line 6900E

Observations:

(1) *Zn and Cu:* The enzyme leach profiles for Zn and Cu on this line differ markedly from those of line 12900E. Firstly, alluvial sand south of the Fish River Fault is only anomalous within 100m of the Fault (Figure 6). The samples from this area also have high total Zn and Cu responses and were dug from pebbly and ferruginous colluvium. Secondly, elevated enzyme leach responses in the order of those on Line 12900E occur on the north end of line 6900E within skeletal soil developed on mostly outcroppping unit 3 of the Fish Fiver Formation (Pff_3). Another, narrower, anomalous zone occurs on the southern end of the line between 28500 and 28800N.

(2) *V:* Elevated enzyme leach V is only observed in samples from the south-facing colluvial slope of the Fish River Fault. These samples also have high total Mn levels.

(3) *Normalised Profiles:* Unlike line 12900E, normalised Zn anomalous areas lack a strong Cu response. The normalised V anomaly at 28600E occurs within a Zn-anomalous zone, and in detail corresponds to a poorly drained and wet clay-rich area 100m north of a low pavement of Constance Range Sanstone.

(4) *Other Features:* As noted for line 12900E, elevated total K, Ba and low base metal levels in samples south of the Fish river Fault indicate that that much of the sand must be distally derived. Neither the sediments of outcropping Constance Range Sandstone to the south nor Fickling Group to the north explain these chemical patterns unless complex chemical redistribution accompanies the erosion-sedimentation process.

Interpretation

The lack of an enzyme leach Zn anomaly comparable to the 12900E line is attributed to the much weaker and deeper mineralisation of the Mount Les Siltstone at this location (<1wt.% combined Pb-Zn). The Zn-Cu anomalies on the ends of this line are difficult to account for. The northern anomaly may simply be related to outcropping Pff_3 and Pfw_b, because Pff_3 samples also seem to be anomalous on line 12900E (see previous section). The association of the southern Zn-Cu anomaly with a strong normalised vanadium spike is a feature shared by the line 12900E anomaly. Could it be a hydromorphic feature related to mineralisation, or is it just a quirk of local drainage conditions?

Discussion

The enzyme leach patterns for Zn and, to a lesser degree, Cu, reveal a secondary dispersion halo far larger in area than that produced by erosion of mineralised material from the exposed Fish River Fault. The critical question is whether the loosely bound metal of the halo was introduced hydromorphically (*i.e.*, by groundwater) or electrochemically as some kind of vapour phase.

Apart from the coincidence of vanadium- and zinc-anomalous sands (where normalised to Mn) south of the Fish River Fault, none of the so-called 'oxidative suite' metals like As and Mo display patterns of interest. Therefore it is probably safe to conclude that the Walford Creek Zn-Pb (Cu) resource is not coupled to the surface electrochemically.

If the surface enzyme leach anomaly is a hydromorphic feature, was the metal transported vertically into the cover materials or horizontally? At Ernest Henry there is strong evidence of vertical hydromorphic dispersion of ore metals into unconsolidated overburden (Hannan, 1995c). However, at Walford Creek the present topography indicates that there could be groundwater flow from north to south, with outcropping Fickling Group rocks and the mineralised Fault as part of the catchment. If so, it cannot be concluded from this survey that hydromorphic metal halos will necessarily occur vertically above blind mineralisation at other locations. However, it is likely that Walford Creek analogues with extensive hydromorphic halos await detection, because most of the significant Pb-Zn deposits in the Gulf are bound by faults with complex movement histories.

The 300m wide enzyme leach anomaly on the south end of Line 6900E could be an artifact of local drainage conditions, but it should be checked against existing target models because of it's similar chemical make-up to the large 12900E anomaly.

References

Hannan, K.W., 1995a, Partial Extraction Soil Surveys: Covered Copper Deposits, Northern Chile: MIMEX Technical Report 2670.

Hannan, K.W., 1995b, Ernest Henry Enzyme Leach Survey II: MIMEX Memorandum 28/12/95 (7pp, 5 figs.).

Hannan, K.W., 1995c, Hydromorphic Chemical Dispersions above the Ernest Henry Cu-Au deposit: MIMEX Memorandum 1/8/95 (6pp, 5 figs.).

Webb, W. and Rohrlach, B., 1992, The Walford Creek Prospect - an exploration overview: Exploration Geophysics, v.23, 407-412.

K.W. Hannan

cc. ***K. Hannan***
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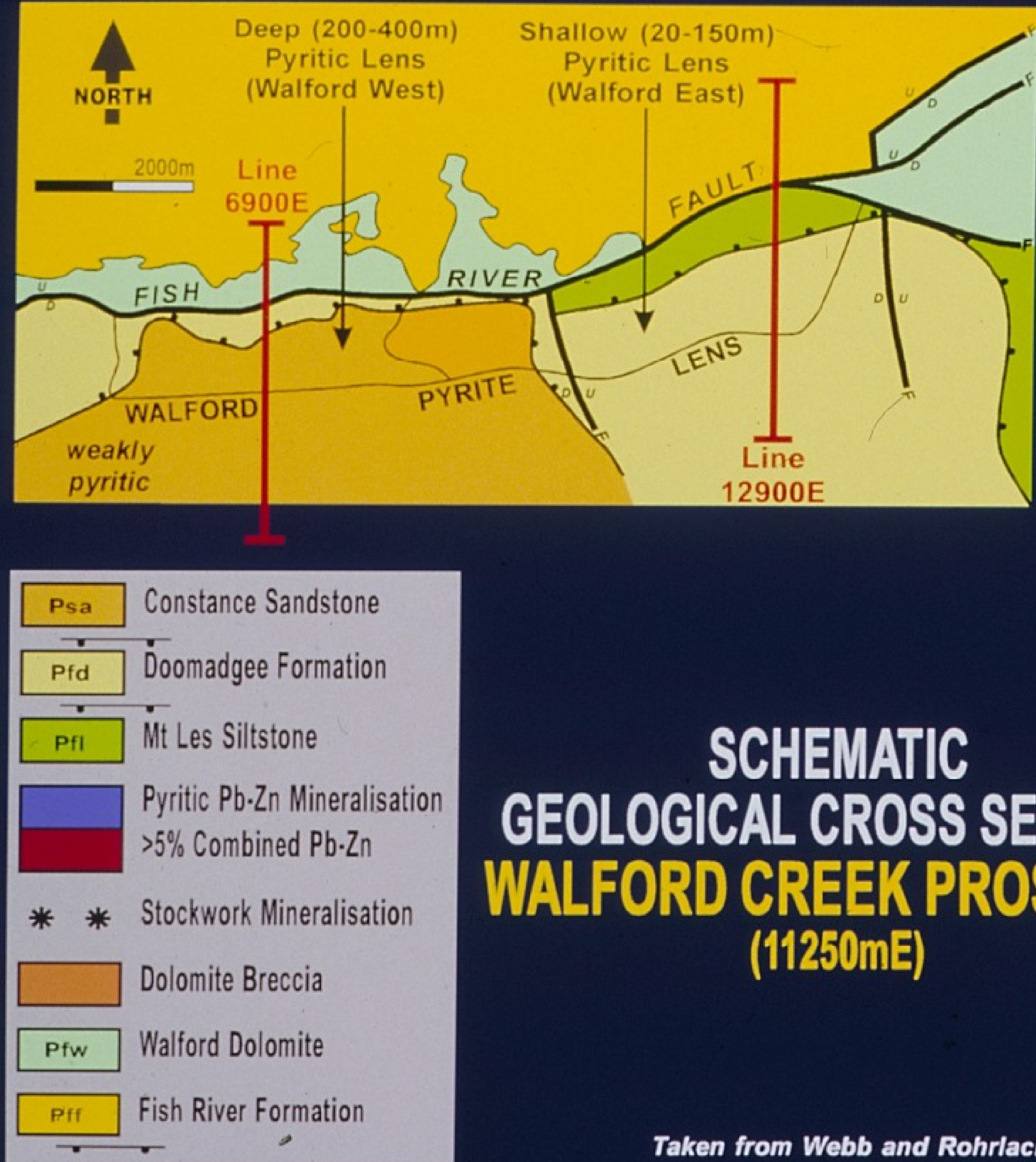
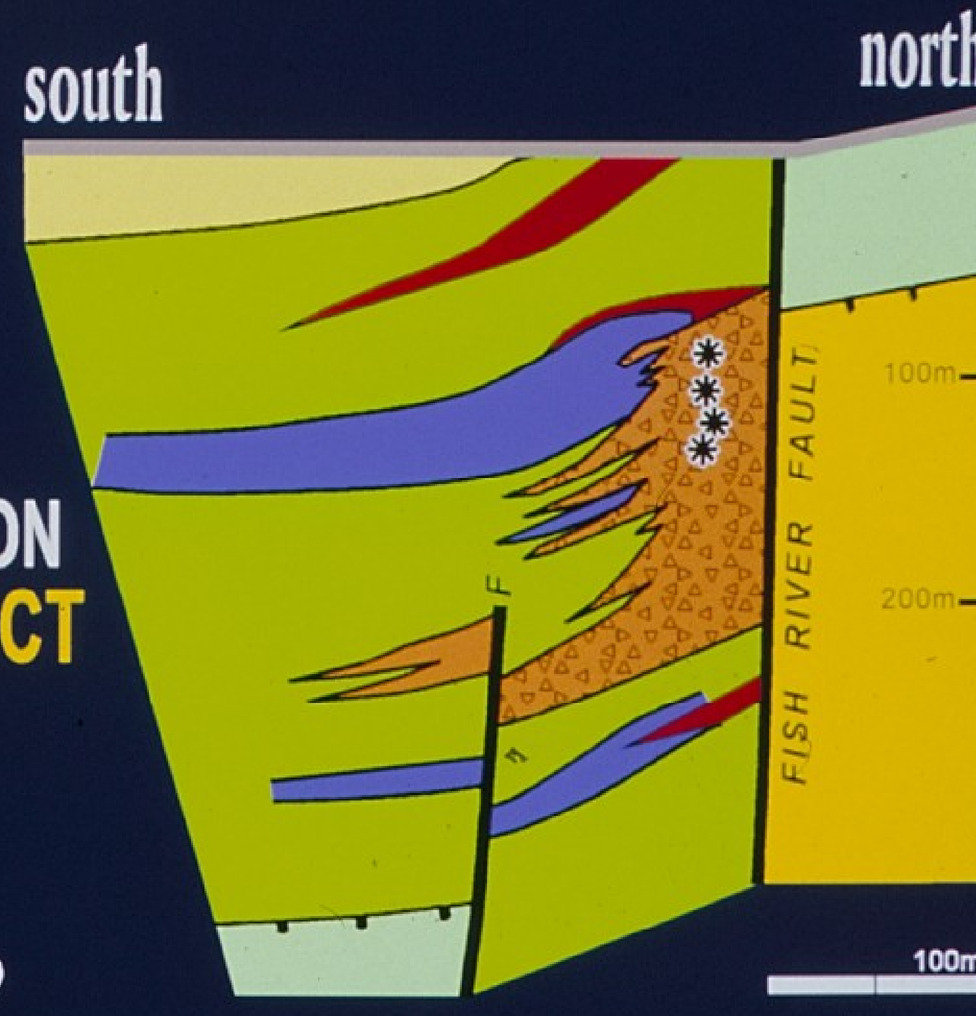


SUMMARY GEOLOGICAL PLAN
WALFORD CREEK PROSPECT
ILLUSTRATING THE EXTENT OF THE PYRITE

SCHEMATIC GEOLOGICAL CROSS SECTION
WALFORD CREEK PROSPECT
(11250mE)



Taken from Webb and Rohrlach (1992)

Plate 1

Plate 2

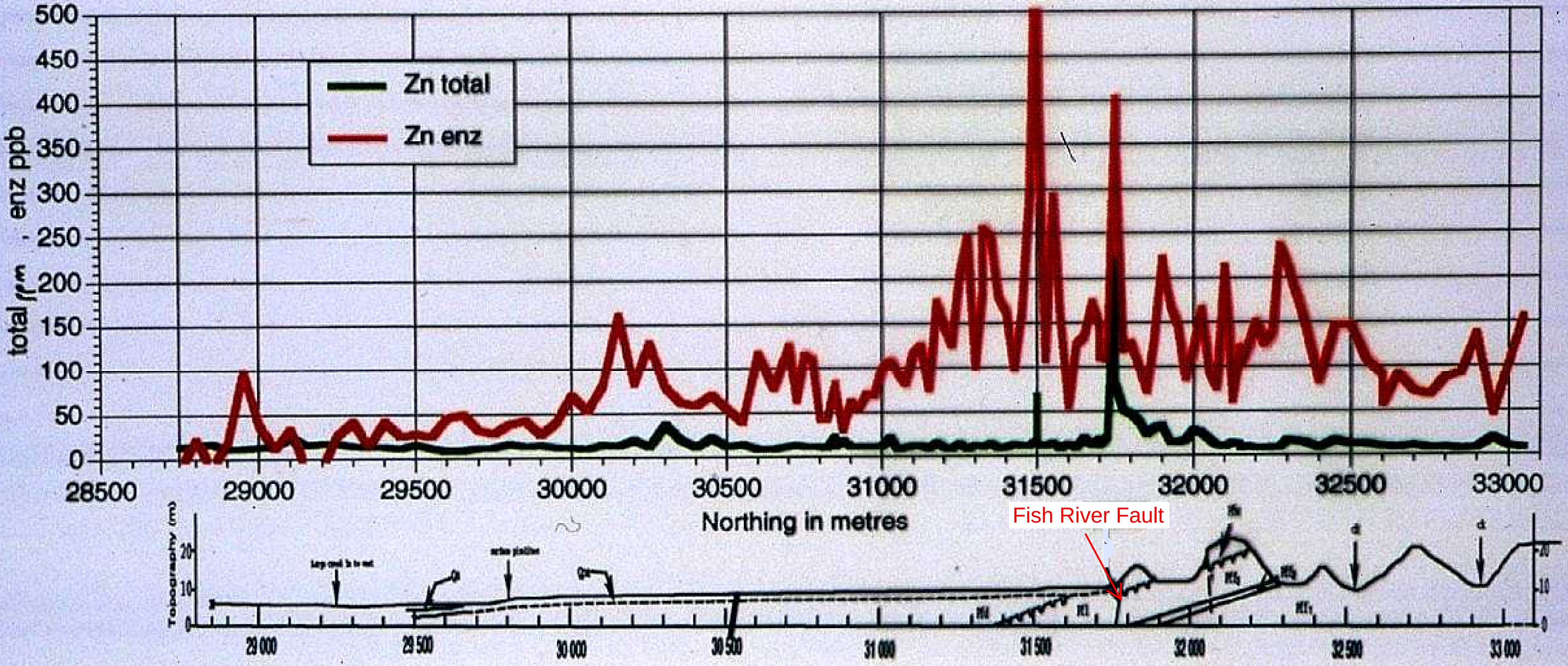


Figure 1 upper

Walford Creek : Line
12900 E Orientation

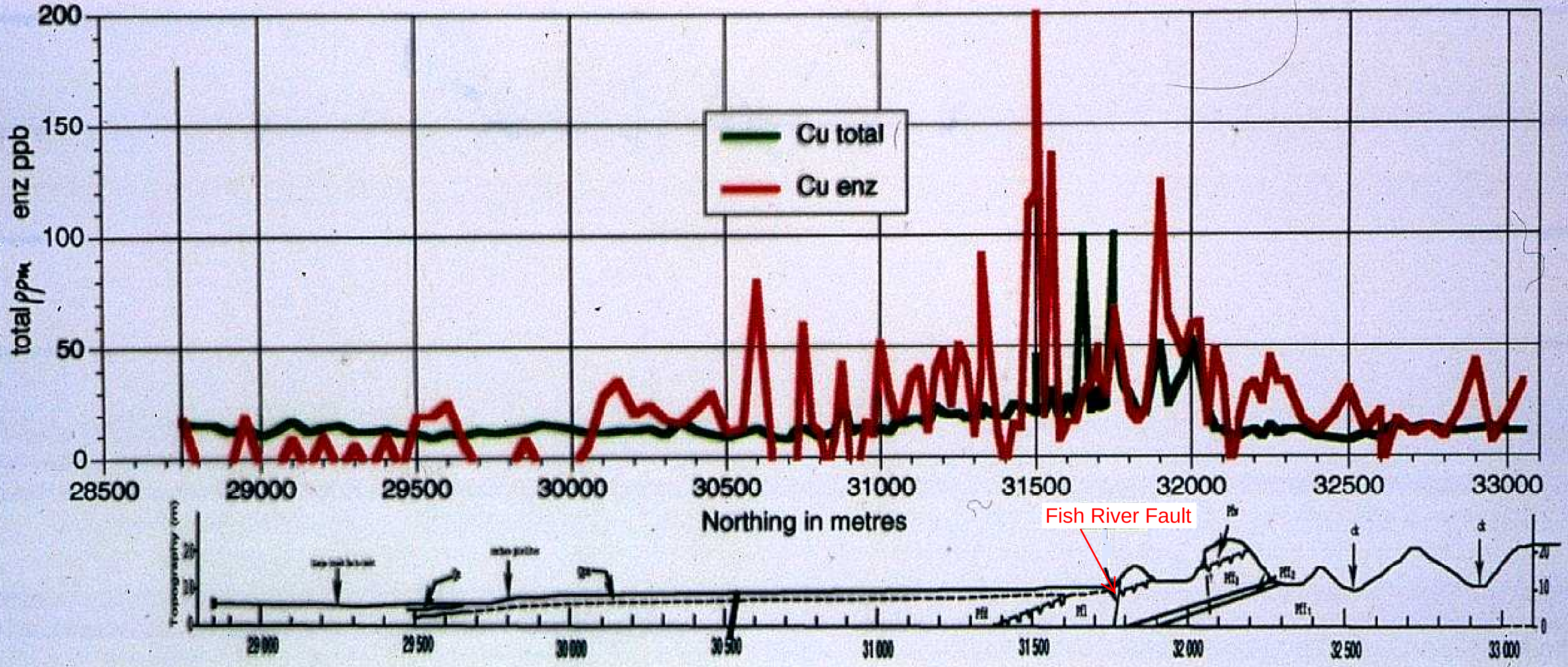
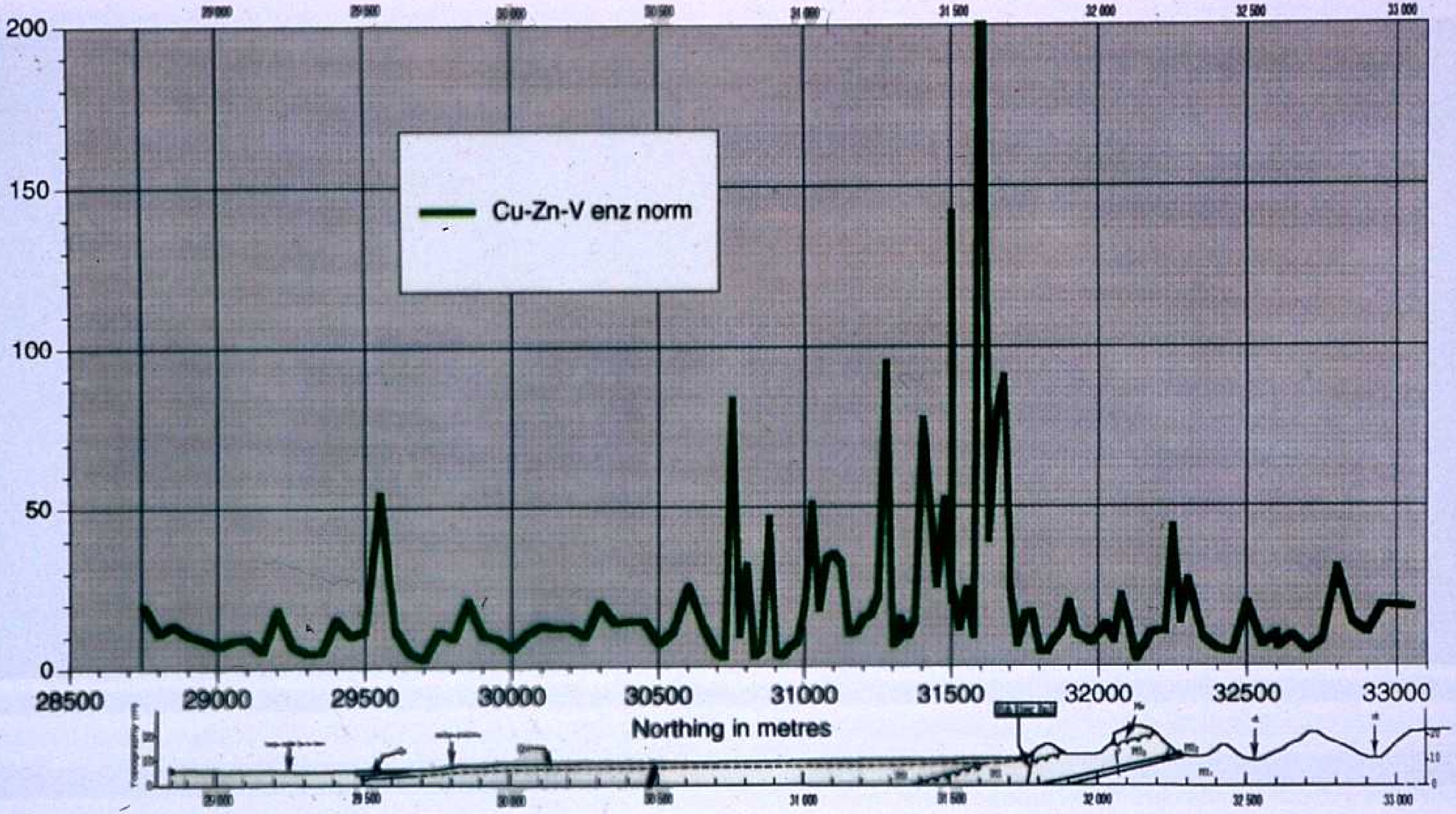


Figure 1 middle

Walford Creek : Line
12900 E Orientation



Walford Creek : Line
12900 E Orientation

Figure 3