

Mineral Reconnaissance Programme

Report No. 93

**Stratabound base-metal
mineralisation in Dalradian rocks
near Tyndrum, Scotland**

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DATA PACKAGE: DETAILED INFORMATION AVAILABLE FOR THE TYNDRUM AREA.

A detailed information package is itemised below, comprising a report with geological, geochemical and geophysical maps and sections. A charge of £250 will be made for a copy of this information, consultation with staff and examination of drillcores (held at BGS Edinburgh).

Report

Summary

Scope of present investigation

General geology

Geology of the mineralised zones

Geochemical surveys

Geophysical surveys

Petrography and mineralogy

Drilling, including XRF analyses of 160 core samples for 13 elements

Discussion and conclusions

Acknowledgements, References

Appendices:

- I Tabulated petrographic notes on 135 samples
- II Geochemistry of 120 surface rock samples
- III Analyses of Fe-rich seepage samples
- IV Geochemical results on soils and basal tills - computer listings and 4 maps
- V Field methods of analysis of overburden samples for copper and zinc (Figures 1-4)
- VI IP, VLF-EM and magnetic profiles (Figures 1-21)
- VII Negative IP effects - an interpretation
- VIII Logs of boreholes 1-4 (total drilling 367 m)
- IX Geochemical data on Auchtertyre drillcore samples

Geochemical listings in folder

Large maps in roll:

Geological map at 1:10 000 scale

Geochemical drainage maps (6)

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SUMMARY

Stratabound zones of base metal enrichment in Middle Dalradian metasediments known from the Tyndrum district in the western Grampian Highlands are comprehensively documented in the accompanying data-package. The main zones lie in the Ben Challum Quartzite, a newly recognised horizon occurring between the Ben Lawers Schist, at the top of which there is a horizon of cupriferous pyrite, and the Ben Lui Schist, at the base of which a chromiferous horizon is developed.

The distribution of mineralisation over some 9 km of strike-length between Tyndrum and upper Glen Lochay has been mapped at a scale of 1:10 000 and integrated geophysical, geochemical and mineralogical studies carried out. Four boreholes were sited on selected anomalies and the resultant core analysed.

INTRODUCTION

Reconnaissance of the Dalradian strike-length westwards of Aberfeldy commenced after publication (Coats, Smith and others, 1979) of the results which led to the opening of Foss Mine (Gallagher, 1984). It was guided by a concurrence of favourable lithostratigraphy and geochemical drainage anomalies derived from the Regional Geochemical Reconnaissance Programme (1:250 000 Argyll-Tiree sheet). Three new stratabound metalliferous horizons (nos. 4-6 in Table 1) were found in the Tyndrum area and a thin, non-economic extension of the Foss Mine horizon (no. 2) located near Loch Lyon. Scientific interpretation of these new stratabound mineral discoveries is discussed elsewhere (Smith and others, 1984; Fortey and Smith, 1986; Coats and others, 1984).

Following the recognition of stratabound mineralisation east of Tyndrum, geophysical surveys of the accessible westernmost 4 km of strike-length, mapping at 1:10 000 scale of the full strike-length extending northeast over the mountain of Ben Challum (1022 m OD) and detailed geochemical sampling of stream alluvium, glacial overburden and soil, spring seepages and waters was completed in 1980. Four boreholes were drilled in Autumn 1981, and full lithological and analytical details are given in the data package itemised at the front of this report.

Subsequent research and exploration to the west of Tyndrum has revealed further new evidence of mineralisation. Scott (1987) has described

stratabound copper-lead-zinc mineralisation from Creag Bhocan [NN 315 280], corresponding to horizon 5 (Table 1), and a significant gold-bearing structure has been reported from Cononish [NN 283 288] by Ennex International plc.

GEOLOGY AND MINERALISATION

The Tyndrum area is situated approximately midway along the Scottish Dalradian Belt which stretches for 300 km between Islay and Portsoy (Figure 1). East of Tyndrum metasedimentary and subordinate meta-igneous rocks of the Middle Dalradian (Argyll Group) include the newly recognised Ben Challum Quartzite Formation (Smith and others, 1984). This formation lies above the Ben Lawers Schist at the top of the Easdale Subgroup and beneath the Ben Lui Schist of the Crinan Subgroup (Table 1). Its lateral equivalent in the Aberfeldy area are the dominantly volcanic Farragon Beds in which no mineralisation has so far been detected. All of these rocks are considered to be late Proterozoic or early Cambrian in age.

Structurally, the metamorphic rocks investigated to the east of Tyndrum (Figure 2) lie on the lower limb of a N-facing recumbent syncline and young and dip consistently to the SE. The rocks have undergone epidote-amphibolite metamorphism but as at Aberfeldy (Coats, Smith and others, 1981) the distribution of the stratabound sulphide mineralisation has been unaffected except for recrystallisation. Faulting, most notably the NNE-trending Auchtertyre Fault, does however displace the lithostratigraphy and the mineralised zones.

Glacial deposits are widespread on valley sides but in stream sections and on precipitous mountain faces exposure is adequate to trace a detailed lithostratigraphy (Figure 2-3).

Two horizons within the Ben Challum Quartzite contain significant amounts of pyrite, together with variable amounts of sphalerite, chalcopyrite, galena and manganiferous garnet. The lower, the Auchtertyre horizon (no. 4, Table 1) extends for at least 8 km of the strike-length of the host formation (Figure 2), and in the Allt Auchtertyre-Allt a'Chaol Ghlinne section (Figure 3) it has a true thickness of about 80 m. The highest values of up to 1.6% Zn and 0.1% Cu occur over a zone of 3 m. In the upper Ben Challum horizon (no. 5, Table 1) the highest values are 3.0% Zn, 0.1% Pb occurring in a zone with a true thickness of 1 m. Within the

Table 1. Middle Dalradian metalliferous stratigraphy

Subgroup	Formation	General lithology	Mineralised horizon
Crinan	Ben Lui Schist	Quartz mica-schist	6. Fuchsite, chromite
Easdale	Ben Challum Quartzite	Quartzite	5. Sphalerite, galena, chalcopyrite
			4. Sphalerite, chalcopyrite
	Ben Lawers Schist	Calc mica-schist	3. Cupriferous pyrite
	Ben Eagach Schist	Graphitic schist and quartzite	2. Baryte, sphalerite, galena (Foss deposit)
			1. Sphalerite, galena, baryte (Ben Eagach deposit)

Adapted from Coats, Pease and Gallagher, 1984

investigated area east of Tyndrum the Ben Challum horizon is 10–20 m thick, extending for some 4 km of strike, but recent mapping by Scott (1987) has demonstrated its recurrence 5–7 km further to the SW at Creag Bhocan where the copper content is much higher.

Two other horizons of mineralisation are present in the Auchtertyre district east of Tyndrum but neither are of economic significance. A zone of pyrite schist up to 100 m thick is developed near the top of the Ben Lawers Schist, beneath the Ben Challum Quartzite. Above the quartzite formation, near the base of the Ben Lui Schist, are bands of chloritic and tremolitic schist containing chromite, fuchsite (chromium mica), chromian magnetite and traces of copper and nickel sulphide.

GEOCHEMICAL SURVEYS

Prior to the discoveries of stratabound baryte and base metals at Aberfeldy, some 60 km ENE of Tyndrum (Coats, Smith and others, 1979), copper anomalies arising from RGRP sampling had led to the identification of vein mineralisation on the northern side of Ben Challum and zinc-copper sulphides had been reported from the Allt Auchtertyre (Smith and others, 1977), 4.5 km to the SW. Cluster analysis based on regional stream sediment sampling at 31 sites is discussed.

On the basis of the Aberfeldy stratabound model, the Auchtertyre-Ben Challum district was re-examined in 1979 and rare outcrops and

boulders of stratabound zinc, copper and lead mineralisation discovered. Detailed geochemical surveys in 1980 comprised (a) base metal analyses of 134 stream sediments and 124 panned concentrates; (b) copper and zinc determinations on water samples and on iron-rich seepage material from 45 sites; (c) deep overburden sampling and base metal analysis at 165 sites (after orientation work at 13 sites in 1979); and (d) analysis of shallow overburden samples from nearly 600 sites. It was concluded that after the use of drainage geochemistry to outline the stratabound metalliferous zones, deep overburden sampling was the most reliable method of depicting the subsurface extent of the zones at a detailed scale.

GEOPHYSICAL SURVEYS

Utilising VLF-EM, total magnetic field, IP and SP methods, 3.8 km of strike-length was investigated in the SW section of the zone of stratabound mineralisation. The best geophysical response to the projected position of the Auchtertyre horizon was by IP and the resultant anomaly is closely coincident with the main zone of zinc enrichment in overburden (Figure 3b). Both geophysical and geochemical anomalies are interrupted east of the Auchtertyre Fault (Figure 2) for some 400 m due to thick till (Figure 3a). However, some high chargeabilities at large dipole separations were noted in this section, suggesting continuity of the Auchtertyre horizon beneath the till. Bifurcation of the main chargeability

anomaly in the NE is possibly due to faulting.

The second main IP anomaly lies at the SE margin of a very strong, narrow, in-phase VLF-EM feature running for some 2 km within the Ben Lui Schist. The anomalies are tentatively attributed to the presence of graphitic schist units (g on Figure 3a) but require further investigation in view of the proximity of chromiferous rocks (Forthey and Smith, 1986). No geophysical response arises from the Ben Challum sulphide horizon, deduced in the area of Figure 3 from sparse outcrop and geochemical evidence. Weak IP anomalies in the northerly parts of the area correlate with the pyrite zone in the Ben Lawers Schist and magnetic features are due to Permo-Carboniferous quartz-dolerite dykes.

CONCLUSIONS

The two sphaleritic quartzite horizons in the Ben Challum Quartzite are thick and extensive. Some of the mineralised quartzites may be metacherts (Fisk, 1986) and the sulphides clearly formed before metamorphism. Feldspar enrichment in sulphidic laminae is also indicative of early diagenetic or exhalative formation. Zinc-lead bands of ore grade in the Ben Challum horizon may represent thin exhalites. Their presence will encourage further exploration of the Ben Challum Quartzite. The strong geophysical anomalies in the basal part of the Ben Lui Schist also require investigation.

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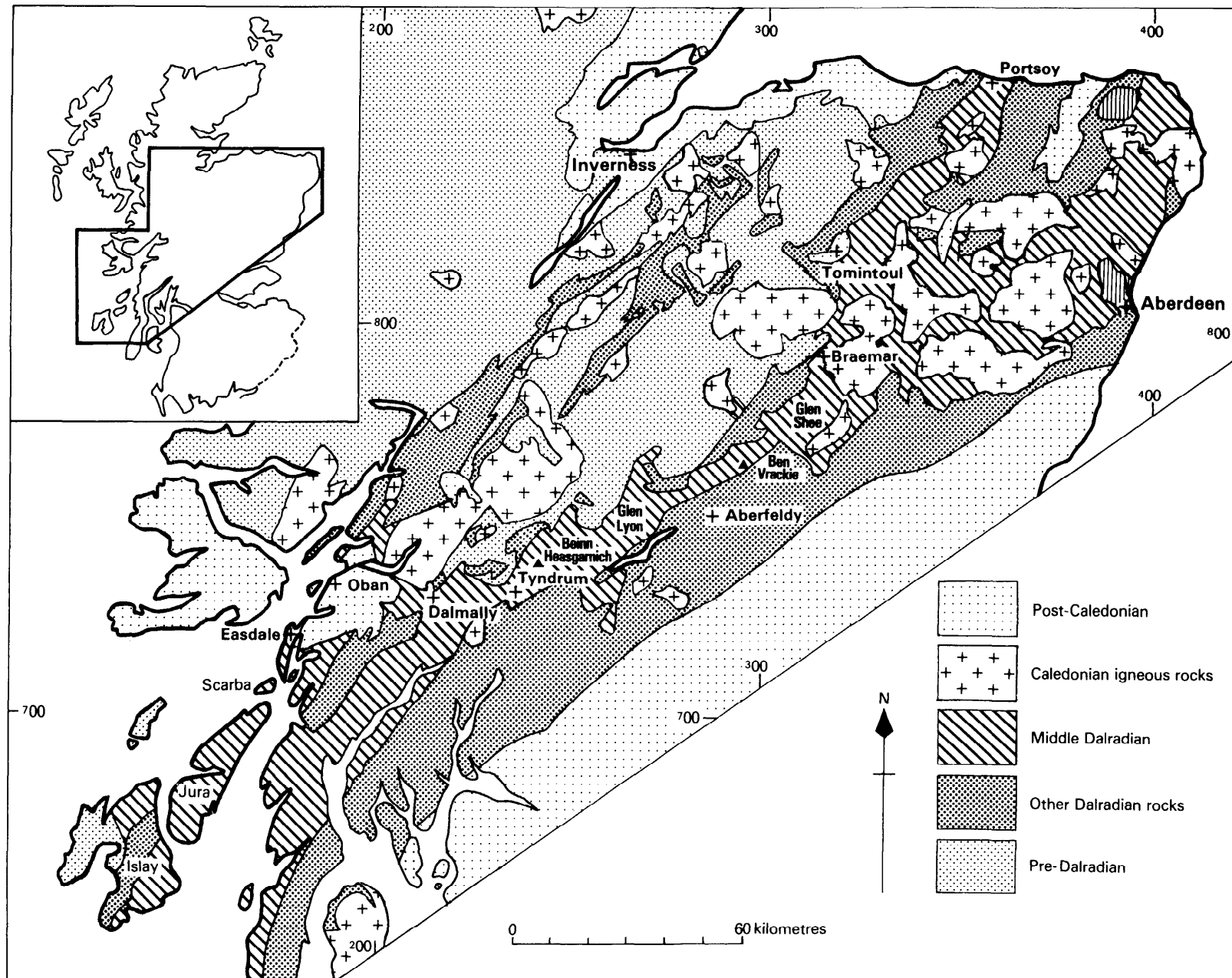


Figure 1 Location of Tyndrum in the Dalradian belt of Scotland

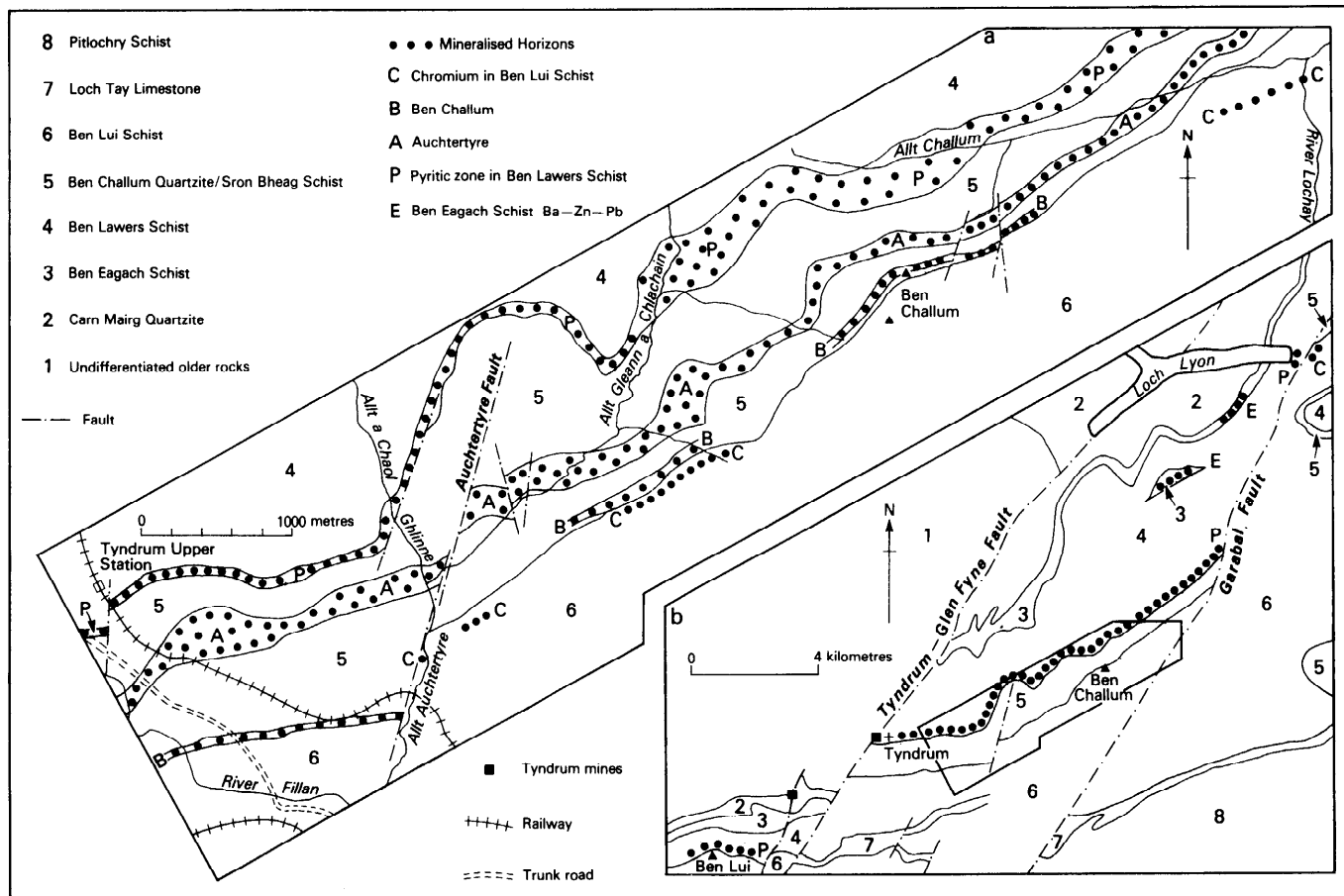


Figure 2 a Stratabound mineralisation in the Dalradian of the Tyndrum–Ben Challum area; and b its spatial relationship with the Loch Lyons horizons and the Tyndrum mines

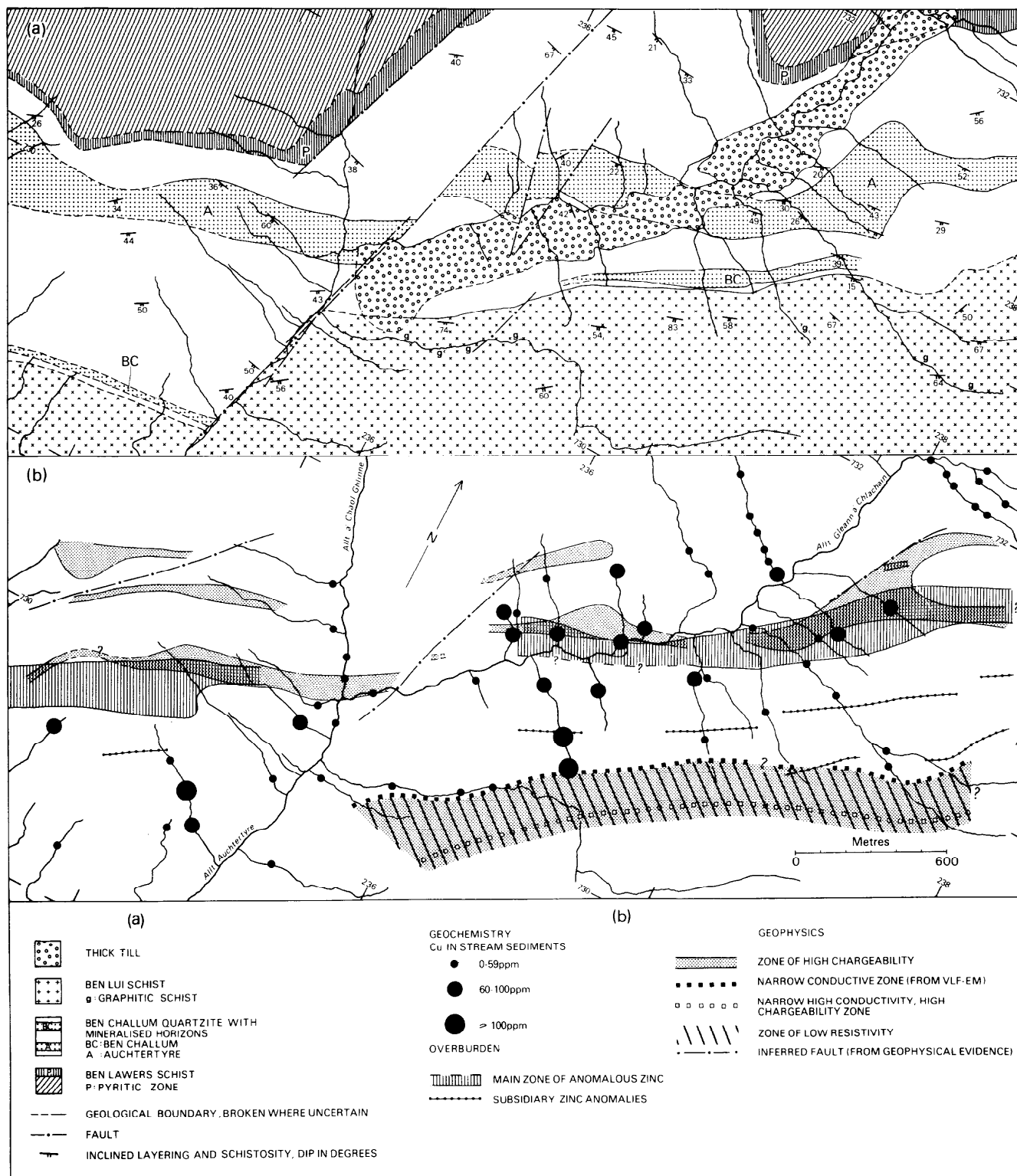


Figure 3 Allt Auchertyre area east of Tyndrum: a geology and mineralisation; and b results of geophysical and geochemical surveys