DEPARTMENT OF MINES AND ENERGY

GEOLOGICAL SURVEY

SOUTH AUSTRALIA

REPORT BOOK 92/60

SOIL AIR CO_2/O_2 PROJECT PROGRESS REPORT II, MOONTA DISTRICT

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DEPARTMENT OF MINES AND ENERGY
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INTRODUCTION

Soil air carbon dioxide (CO_2) and oxygen (O_2) measurements as a guide to oxidising sulphide have been assessed by several researchers and government geological surveys in the United States, Ireland, Africa and Saudi Arabia (Lovell et al 1983; Hinkle and Dilbert, 1984; Reid and Rasmussen, 1990; Ball et al, 1990 and McCarthy Jr and Bigelow, 1990). The rationale is that sulphide oxidation in the presence of water and oxygen will produce sulphuric acid which in turn will attack any carbonates present to produce CO_2. Oxygen is consumed in the process. Both CO_2 and O_2 are easily measured to an acceptable accuracy in the field with portable equipment.

The soil air CO_2/O_2 project is being conducted jointly between the author (consultant) and the South Australian Department of Mines and Energy (SADME). The aim of the project is to test the technique over areas of known mineralisation in a variety of geological and geographical settings. Progress Report I detailed testing in the Mount Lofty Ranges (Watmuff, 1992) and this report details trials in the Moonta area.

The cooperation of Moonta Mining NL in allowing access to mineralised areas is greatly appreciated.

CASE HISTORY

Moonta Area

Copper was mined from the Moonta area from the 1860s to 1923. The ore occurred in sub-parallel NW-SE trending fracture zones, hosted by Moonta porphyry and contained within an area of several tens of square kilometres. Twenty seven years of exploration by Western Mining Corporation and North Broken Hill led to a new copper discovery in 1987. This work is reported in SADME Envs 6999, 7001 and 8368.

Modern open-cut mining commenced in 1988 on an extension to the old Poona lode containing an insitu undiluted ore reserve of about 180,000 tonnes averaging 7.1% copper and 2.0 grams per

tonne gold above a cut-off grade of 2% copper (1987 estimate). A second open cut operation was also developed on the Wheal Hughes lode 1.6 km to the south. Primary Poona lode ore consisted of a coarse grained chalcopyrite - pyrite assemblage in quartz - tourmaline - chlorite - feldspar(minor) gangue. Supergene sulphides were chalcocite and covellite.

Four traverse locations were chosen over the Poona, Wheal Hughes, Paramatta and Mid Moonta lodes in the Moonta area for soil $CO_2/\Delta O_2$ and a fifth over the Alford prospect a few kilometres NE of Kadina (figures 1 & 2). All traverses were within cereal paddocks or cleared land. Vegetation comprised dried grass and/or stubble with minor fresh autumn germination following recent rain.

Wheal Hughes

Traverses were made across the SW extension of the current Wheal Hughes pit along mine grid line 9960N in March and July 1992. Seven drill holes provide good subsurface mineralisation control (figure 3) and pit exposure 30 m away to grid north provides detailed overburden and weathered profile information (figure 4).

The $CO_2/\Delta O_2$ data are plotted in figure 3 and tabulated in tables 1 & 2. The March values show excellent correlation with sub-surface mineralisation. Soil air over footwall rocks measures between 0.25% and 0.35% for CO_2 and 0.1% to 0.3% for ΔO_2. Passing over the ore horizon and then the hanging wall, there is a sharp, three to four fold increase in both CO_2 and ΔO_2 which fades away to background as the ore horizon dips deeper to the northwest.

The winter measurements followed above average seasonal rains in late autumn and early winter. Grasses, broadleaf plants and legumes were thick and lush over the footwall rocks, some of the ore zone and to a lesser extent the hanging wall. Background values were typically double those of March but the main anomaly peak was also significantly enhanced. Two relatively high values over footwall rocks at 2040 and 2050mE may be due to biological activity or may reflect another pathway of CO_2 gas escape from known or unknown mineralisation. The lowest background values coincided with bare ground or relatively little surface vegetation at the far western end of the traverse. The oxygen deficit may deviate significantly from its corresponding CO_2 value in contrast to the March results.

No carbonate has been described within the Moonta porphyry or the ore gangue. If indeed there is no carbonate, alternative explanations for the existence of the anomaly must be considered. Possibilities include:

a) migration of SO_2 into the calcrete layer where gas sampling took place; or
b) bacterial activity in the oxidising sulphide ore.

Paramatta Lode

A traverse was made approximately normal to strike across the main Paramatta lode (Fig 2), a site

undisturbed since early mining in the Moonta area, and 500 metres north of Wheal Hughes. Percussion drilling by the WMC-NBH Moonta Wallaroo joint venture partners on a small unmined shoot about 150 m south of the main lode gave two intersections (in separate holes - MP683 and MP684) which averaged approximately 1.9 m @ 20% pyrite and 0.65% copper as chalcopyrite and 1.9m @ 9% pyrite and 0.95% copper as chalcopyrite, at depths below surface of 68 m and 26 m respectively. A third hole (MP601), in a separate traverse of six percussion holes across the main lode, intersected massive gossan containing quartz but no sulphide between 10 m and 14 m below surface. Only rare to trace pyrite and chalcopyrite was reported sporadically through Moonta porphyry in most of the other holes (SADME Env 8368).

The upper part of the weathered profile comprises a few centimetres of loam overlying 2 m to 3 m of nodular calcrete grading downwards to red-brown and sometimes pale clay which persists to a depth of 6 m to 12 m. Below this, red-brown oxidised Moonta porphyry grades down to a fresh grey colour.

The soil air traverse passes a few metres east of the Main Shaft (No 3) and west of No 4 shaft, intersecting the line of shafts at 7mS along the traverse. It is sub-parallel to the linear traverse of six percussion holes (MP602 to MP597) 15 m to 25 m to the northeast. The gas data and relevant strike projected drillhole data are plotted in figure 5 and tabulated in table 3. Soil CO_2 values are only 1½ to 2½ times background over the ore zone. The oxygen deficit shows general correlation with CO_2, but the higher values over the ore zone do not give an anomaly as broad as CO_2. The lower anomaly/background contrast compared to Wheal Hughes probably reflects the weakness of the remaining mineralisation at Paramatta lode.

A short traverse across the small ore shoot intersected by holes MP683 and MP684 in winter (July 1992) did not give a clear anomaly response. Winter grass growth was lush and background CO_2 values relatively high and more variable than in autumn. The data are given in table 4.

Mid Moonta Lode

Mid Moonta was a small lode about 1 kilometre due east of Wheal Hughes (Fig 2). A soil gas traverse across strike between the third and fourth shaft going NE along strike yielded no anomalous values (table 5). Subsequent drilling intersected only about 1 m of 1% copper. The CO_2 values were remarkably stable - 0.22% to 0.25% over a distance of 90 m with the exception of one value of 0.31. The oxygen deficit was consistently 0.2%.

Poona Lode

The Poona open cut mine has been exhausted of mineable ore so this lode could not be tested. A soil air traverse was made at the western end of the Poona pit along the old north-south railway line cutting to intersect the approximate centre point of the old Poona lode, mined out in earlier times (Fig 2). The railway rails and ballast had been removed and replaced with a thin veneer of lime (calcrete) rich material. Extreme difficulty was encountered

in driving the probes to 75 cm and this depth was not always attained. The sample horizon appeared to be the red-brown clay below the calcrete horizon. The traverse surface was about 2½ metres below the original ground surface.

The data are plotted in figure 6 and tabulated in table 6. No clear anomalous response was recognised. The mineralisation below the traverse line is probably very weak.

Alford Prospect

Alford prospect occurs in a wheat paddock about 10 km north of Kadina. A soil gas traverse was made north-south across an east-west trending (approximately) line of mineralisation in the vicinity of DDH132 and DDH136 (WMC+NBH Moonta-Wallaroo joint venture 1961-1988, SADME Env 8368).

The primary sulphide mineralisation is both disseminated and in quartz veins. It comprises mainly pyrite (2-3%) with minor molybdenite and chalcopyrite, and is associated with argillic and propylitic alteration in the apical portion of a porphyritic diorite and in metasedimentary roof rocks (figure 7). The propylitic alteration appears to have been overlaped by the argillic alteration in parts. Carbonate occurs throughout the argillic alteration.

Sulphide oxidation is complete to about 110 m below surface and locally extends downward at least 230 m below surface (figure 7). A supergene chalcocite blanket up to 4 m thick with associated pyrite is developed at about 110 m. The deeper oxidation in DDH132 is characterised by native copper and an absence of pyrite.

Percussion drilling and shallow auger drilling in the area by the WMC+NBH Moonta-Wallaroo joint venture partners indicates a near surface profile similar to that in the Moonta area to the south. The calcrete horizon however appears to be more massive rather than nodular and limited probe penetration to 50 cm or less. Top soil is a grey-brown calcareous sand. Weathered bedrock occurs at a depth of 5 m to 7 m below surface.

The soil gas data are plotted in figure 7 and tabulated in table 7. Unfortunately, an accurate location for the drillholes could not be established on the ground at the time of CO_2/O_2 measurement and the traverse was actually made about 50 m west of the collars of DDH132 and DDH136. The interpretive geological section based on the drillhole logs and also aligned north-south is correlated with the gas traverse by making their respective intersections with the approximately east-west trending surface line of mineralisation common. An uncertainty of up to 30 m north or south still exists in the correlation due to the lack of geographical control.

Carbon dioxide in soil air over the prospect area yielded a steady background range of 0.14% to 0.18%. Anomalous values extended up to 0.40% and showed reasonable spatial correlation with the sulphide in the uppermost portion of the redox surface. The oxygen deficit correlates closely with the CO_2 values, but is usually slightly higher.

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TABLE 1

WHEAL HUGHES: SOUTH WEST EXTENSION (24-3-92)

Co-ordinates		CO_2%	O_2%*	Depth(cm)	Comments
Mine Grid					
9960mN	2070mE	0.28	20.9	68	Dry grass. Very weak new germination.
	2060mE	0.25	20.8	75	" "
	2050mE	0.30	20.8	75	" "
	2040mE	0.35	20.7	75	" "
	2030mE	0.32	20.7	75	" "
	2020mE	0.34	20.7	75	" "
	2010mE	1.10	20.0	75	" Weak to moderate new germ.
	2000mE	0.96	20.1	75	" Very weak new germination.
	1990mE	0.73	20.2	75	" "
	1980mE	0.63	20.4	75	" "
	1970mE	0.57	20.5	75	" "
	1960mE	0.50	20.5	75	" "
	1950mE	0.27	20.7	75	" "
	1940mE	0.19	20.8	75	" "
	1930mE	0.20	20.8	75	" "
9953mN	2010mE	0.82	20.2	75	" "

* Air reading = 21.0% O_2

TABLE 2

WHEAL HUGHES: SOUTH WEST EXTENSION (6-7-92)

Co-ordinates		CO_2%	O_2%*	Depth(cm)	Comments
9960mN	2070mE	0.54	20.4	75	30 cm high lush green mixed grasses & broad leaves
	2060	0.43	20.3	75	20 cm "
	2050	0.67	20.3	70	25 cm "
	2040	0.86	19.9	75	30 cm "
	2030	0.63	20.3	75	20-30 cm "
	2020	0.55	20.4	75	10 cm high lush green only 80% ground covered
	2010	1.19	20.0	75	20 cm " +2 acacia bushes 1 m away
	2000	1.19	20.1	75	30-40 cm "
	1990	1.38	18.9	75	15-20 cm "
	1980	1.01	19.7	75	10 cm " only partial ground cover
	1970	0.74	16.1	75	30-40 cm "
	1960	0.49	20.2	75	10 cm " only partial ground cover
	1950	0.47	20.4	75	30 cm "
	1940	0.38	20.5	75	Bare ground
	1930	0.38	20.2	75	Bare ground
	1920	0.37	20.5	75	50% bare ground <5 cm high grasses & broadleaves

* Air reading = 20.9% O_2

TABLE 3

PARAMATTA LODE: TRAVERSE ALONG EAST SIDE OF TRACK EAST OF MAIN SHAFT (25-3-92)

Co-ordinates	CO_2%	O_2%*	Depth(cm)	Comments
50mS	0.30	20.8	75	Dry grass with some new germination.
40mS	0.35	20.8	75	"
30mS	0.55	20.8	75	"
20mS	0.55	20.5	75	"
15mS	0.61	20.4	75	"
10mS	0.65	20.5	75	"
7mS	Line of shafts			
5mS	0.58	20.5	75	"
0mS	0.41	20.6	75	"
10mN	0.40	20.6	75	"
20mN	0.47	20.4	75	"
30mN	0.51	20.3	75	"
40mN	0.46	20.6	75	"
50mN	0.12	20.8	75	"
60mN	0.36	20.8	75	"
70mN	0.27	20.7	75	"
80mN	0.24	20.75	75	"
90mN	0.26	20.7	75	"
100mN	0.28	20.7	75	"

* Air reading = 21.0% O_2

TABLE 4

PARAMATTA LODE: SMALL ORE SHOOT SOUTH OF MAIN LODE (10-7-92)

Co-ordinates	CO_2%	O_2%*	Depth(cm)	Comments
0mS	0.35	20.5	75	Thick lush sour sob 20-40 cm high
10mS	0.39	20.5	75	"
20mS	0.35	20.6	75	"
30mS	0.35	20.6	75	"
40mS	0.29	20.6	75	"
50mS	0.47	20.5	75	"
60mS	0.34	20.55	75	" only 70% ground cover
70mS	0.27	20.6	75	"
80mS	0.46	20.3	75	" +onion weed, broadleaves
90mS	0.36	20.4	75	" "
100mS	0.26	20.6	75	" "

* Air reading = 20.9% O_2

TABLE 5

MID MOONTA LODE (25-3-92)

Traverse east of three shafts, beginning 11 m north of wooden fence post about 3m east of tall steel post in fence line south of the lode.

Co-ordinates	CO_2%	O_2%*	Depth(cm)	Comments
11mN	0.25	n.r.	75	Dried grass. Minor new germination.
20mN	0.31	20.8	75	"
30mN	0.24	20.8	75	"
40mN	0.24	20.8	75	"
50mN	0.24	20.8	75	"
60mN	0.22	20.8	75	"
70mN	0.22	20.8	75	"
80mN	0.23	20.8	75	"
90mN	0.22	20.8	75	"
100mN	0.24	20.8	75	"

* Air reading = 21.0% O_2

TABLE 6

POONA LODE: RAILWAY CUTTING. SURVEY REFERENCE DRILL HOLE 17 M EAST OF 30 M SOUTH (25-3-92)

Co-ordinates	CO_2%	O_2%*	Depth(cm)	Comments
0mS	0.37	20.7	75	No vegetation. Ground very hard for probe penetration.
10mS	0.39	20.7	75	No vegetation. Gas slightly difficult to pull.
20mS	0.46	20.7	75	" "
30mS	0.39	20.6	75	" "
40mS	0.31	20.8	75	" "
50mS	0.33	20.7	75	"
60mS	0.52	20.6	75	"
70mS	0.25	20.8	60	" Difficult to pull gas.
80mS	0.31	20.7	65	" "
90mS	0.34	20.7	70	" "
100mS	0.23	20.9	60	" Easier to pull gas.
110mS	0.28	20.8	60	" "
130mS	0.39	20.7	75	" Gas slightly difficult to pull.
140mS	0.29	20.8	75	" Easy to pull gas.
150mS	0.35	20.7	65	" "

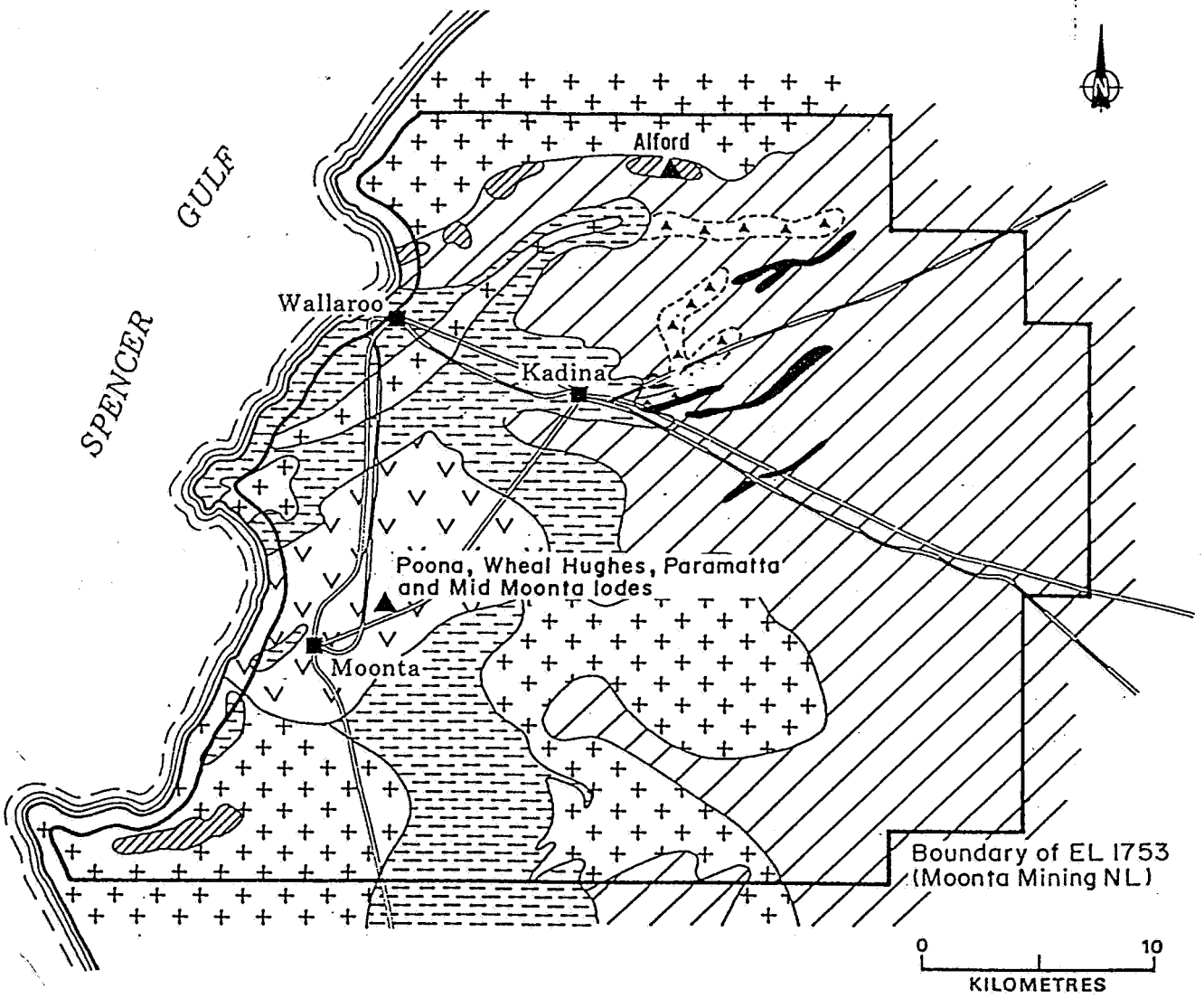
* Air reading = 21.0% O_2

TABLE 7

ALFORD PROSPECT: NORTH-SOUTH TRAVERSE NEAR DDH132 AND DDH136 AND 80M EAST OF NORTH-SOUTH FENCE (26-3-92)

Co-ordinates	CO_2%	O_2%*	Depth(cm)	Comments
30mN	0.17	20.7	45	Dried cereal stubble. Weak new germination.
20mN	0.14	20.7	40	"
10mN	0.15	20.7	45	"
0mN	0.21	20.8	50	"
10mS	0.27	20.7	50	"
20mS	0.24	20.7	50	"
30mS	0.26	20.7	45	"
40mS	0.21	20.7	45	"
45mS	0.31	20.6	50	"
50mS	0.36	20.6	50	"
55mS	0.40	20.5	50	"
60mS	0.32	20.6	45	"
65mS	0.32	20.6	38	"
70mS	0.39	20.5	50	"
75mS	0.39	20.5	45	"
80mS	0.37	20.6	50	"
88mS	Pile of calcrete stones (survey reference)			
90mS	0.31	20.6	50	"
100mS	0.18	20.7	50	"
110mS	0.17	20.8	50	"
120mS	0.16	20.8	50	"
130mS	0.17	20.8	50	"
140mS	0.15	20.8	50	"
145mS	0.19	20.7	50	"
150mS	0.39	20.6	50	"
155mS	0.25	20.7	50	"
160mS	0.19	20.8	50	"
170mS	0.16	20.8	50	"

* Air reading = 21.0% O_2



Granite, partly gneissic

Doora Schist

Moonta Porphyry

Wandearah Metasiltstone

Alteration zone

Black shale

Carbonate breccia

Mineralisation — Poona

SOIL AIR CO_2 and O_2 PROJECT

MOONTA DISTRICT

REGIONAL LOCALITY AND GEOLOGICAL PLAN

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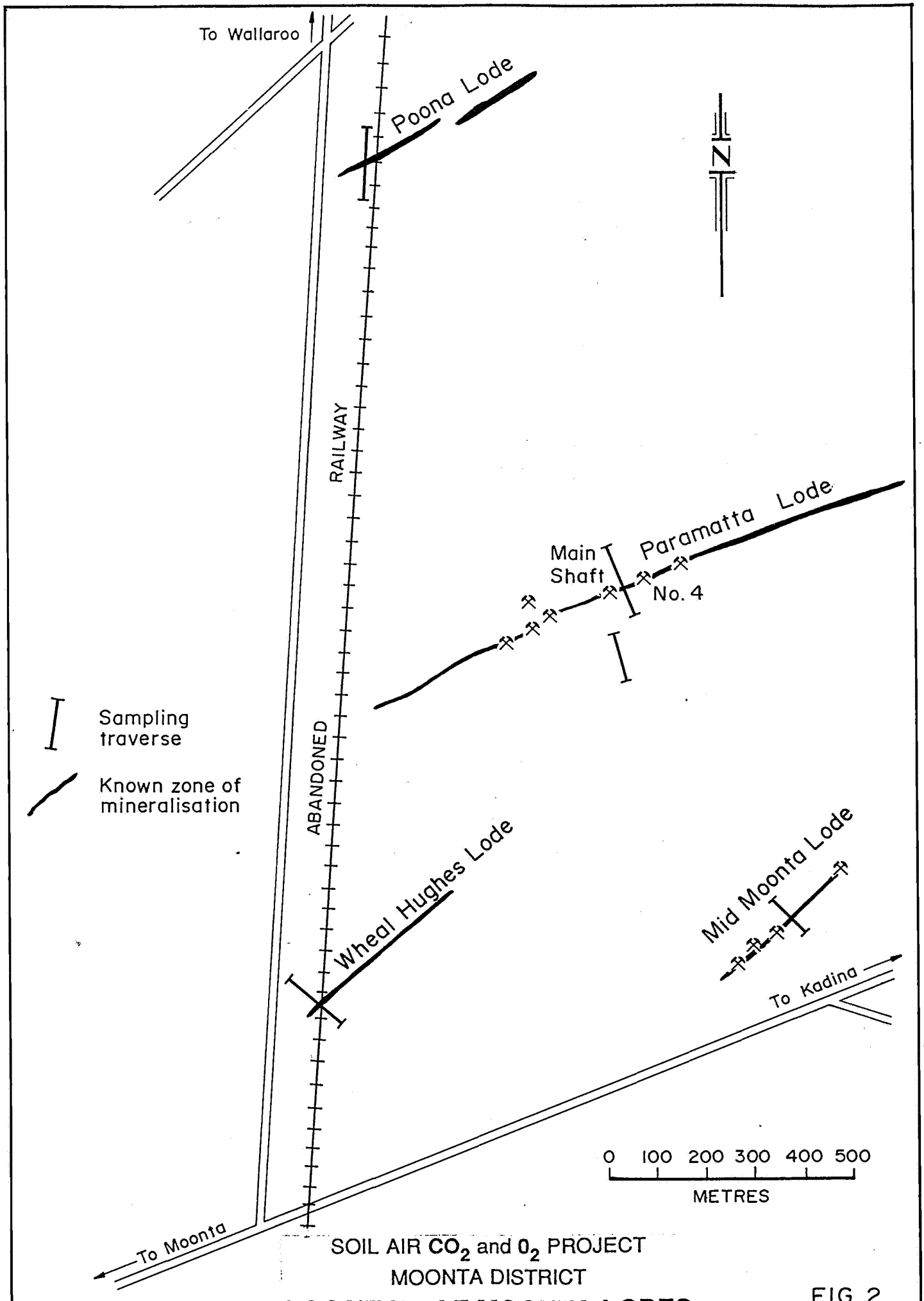
FIG. 1

SADME 92-1093



SOIL AIR CO_2 and O_2 PROJECT

MOONTA DISTRICT

LOCATION OF MOONTA LODES

FIG. 2

SADME 92-1094

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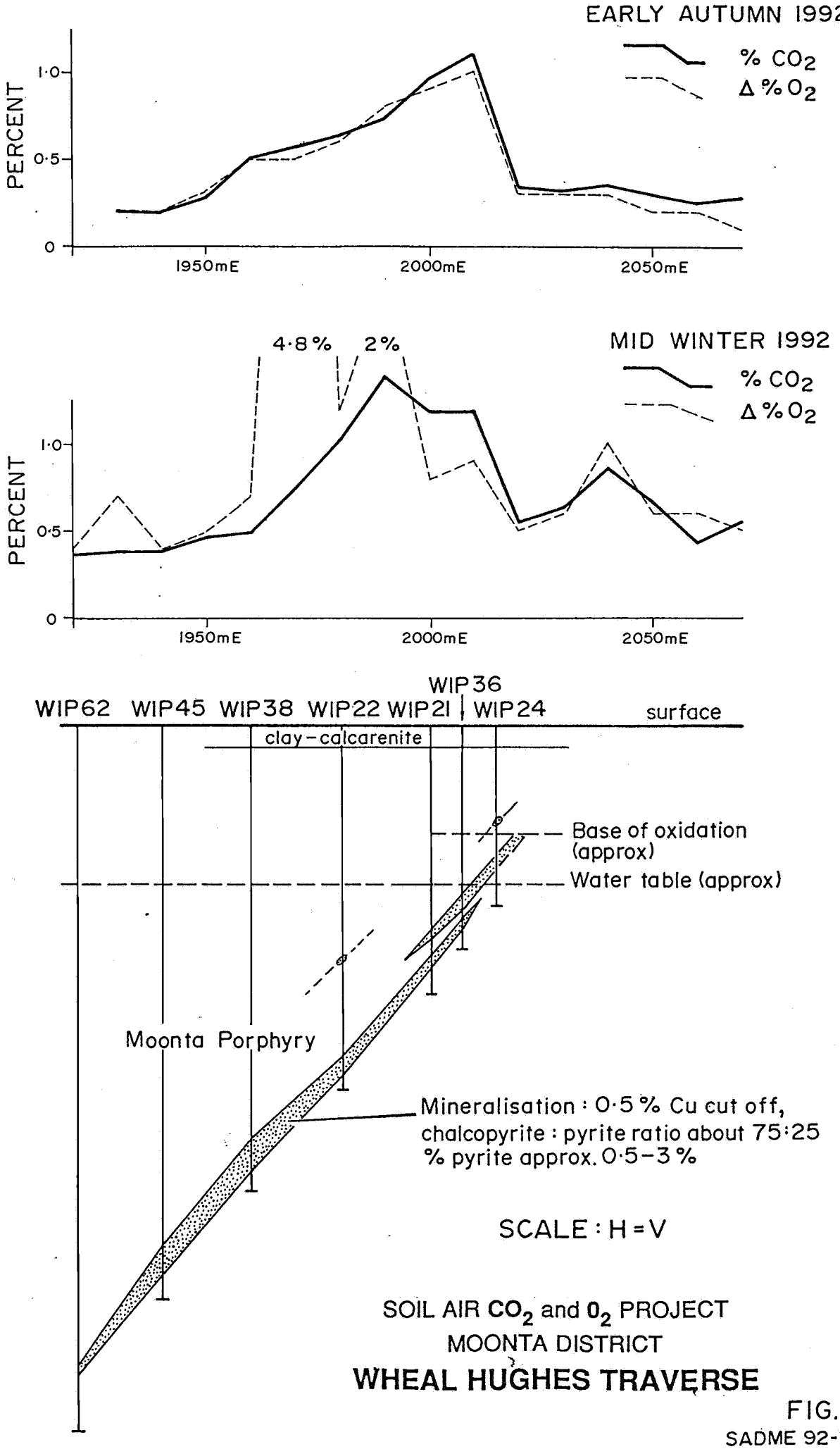
EARLY AUTUMN 1992
% CO2
Δ % O2
PERCENT
1·0
0·5
0
1950mE
2000mE
2050mE
MID WINTER 1992
4·8 %
2 %
% CO2
Δ % O2
PERCENT
1·0
0·5
0
1950mE
2000mE
2050mE
WIP62
WIP45
WIP38
WIP22
WIP21
WIP36
WIP24
surface
clay – calcarenite
Base of oxidation (approx)
Water table (approx)
Moonta Porphyry
Mineralisation : 0·5 % Cu cut off,
chalcopyrite : pyrite ratio about 75:25
% pyrite approx. 0·5–3 %
SCALE : H = V
SOIL AIR CO2 and O2 PROJECT
MOONTA DISTRICT
WHEAL HUGHES TRAVERSE
FIG. 3
SADME 92-1095

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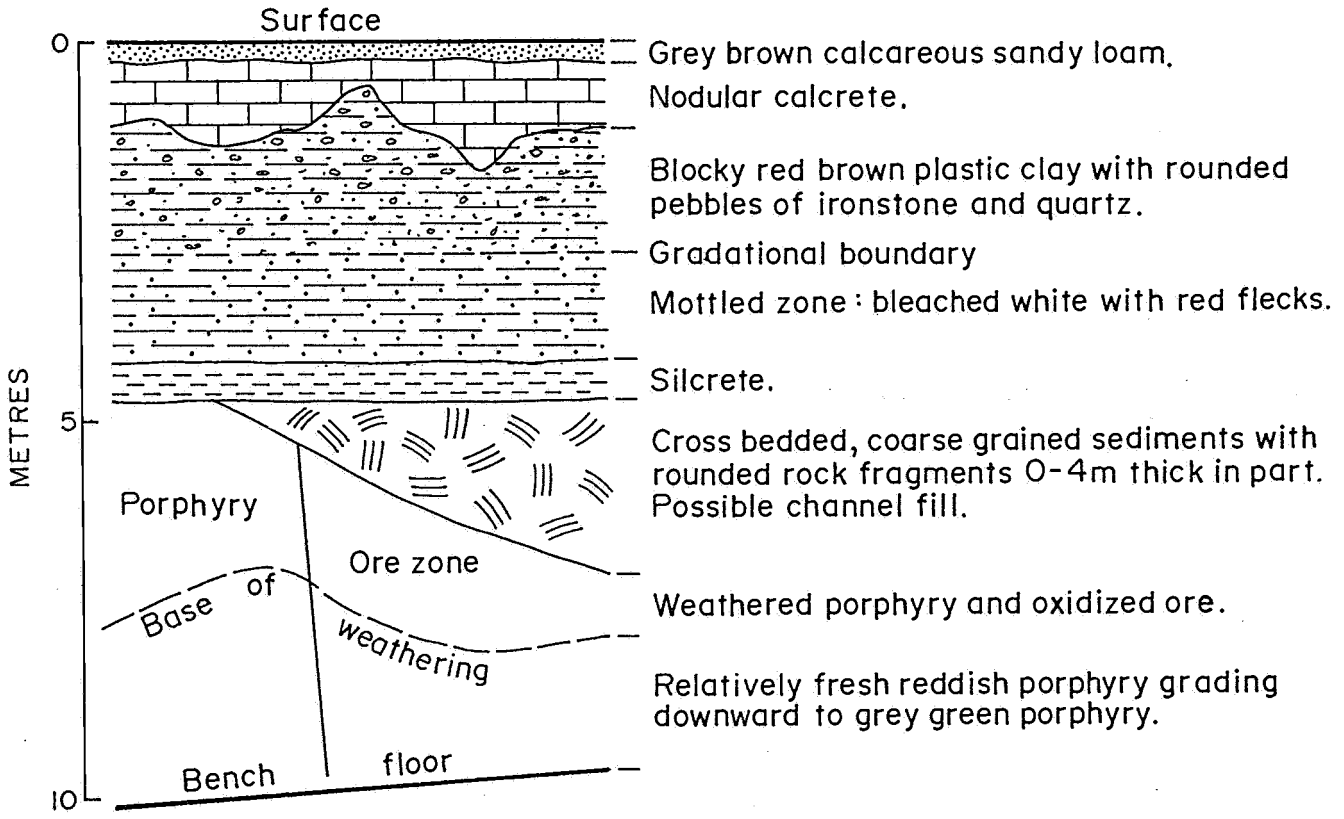

NOTE: Surface to base of weathering generally 12-15m in rest of pit

SOIL AIR CO_2 and 0_2 PROJECT

MOONTA DISTRICT

WHEAL HUGHES PIT, GEOLOGICAL PROFILE

FIG. 4

SADME 92-1096

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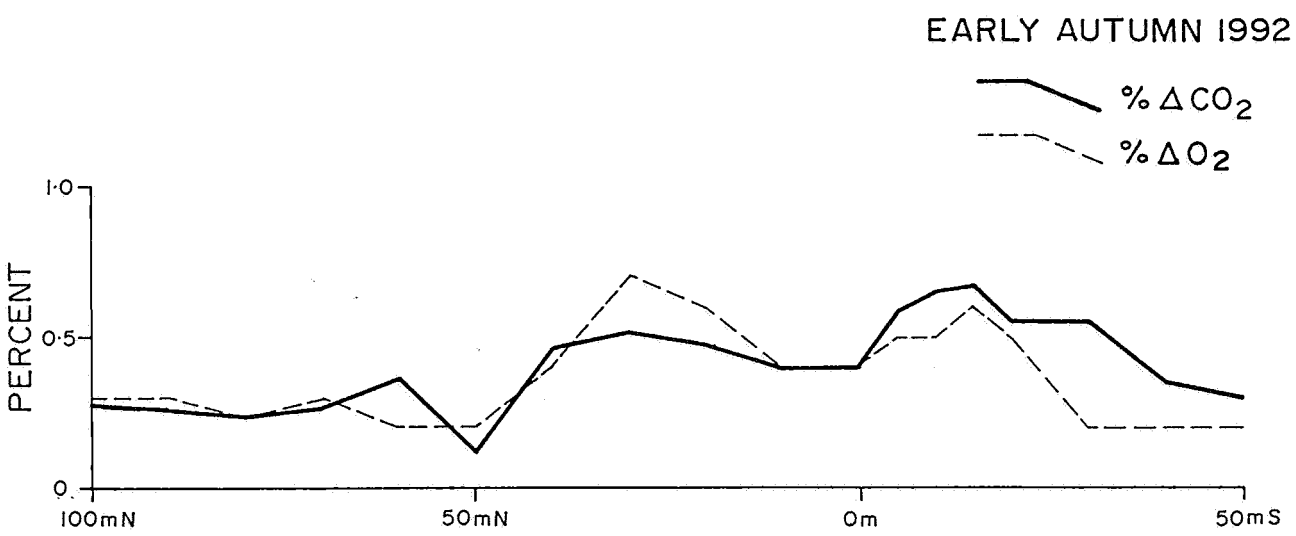

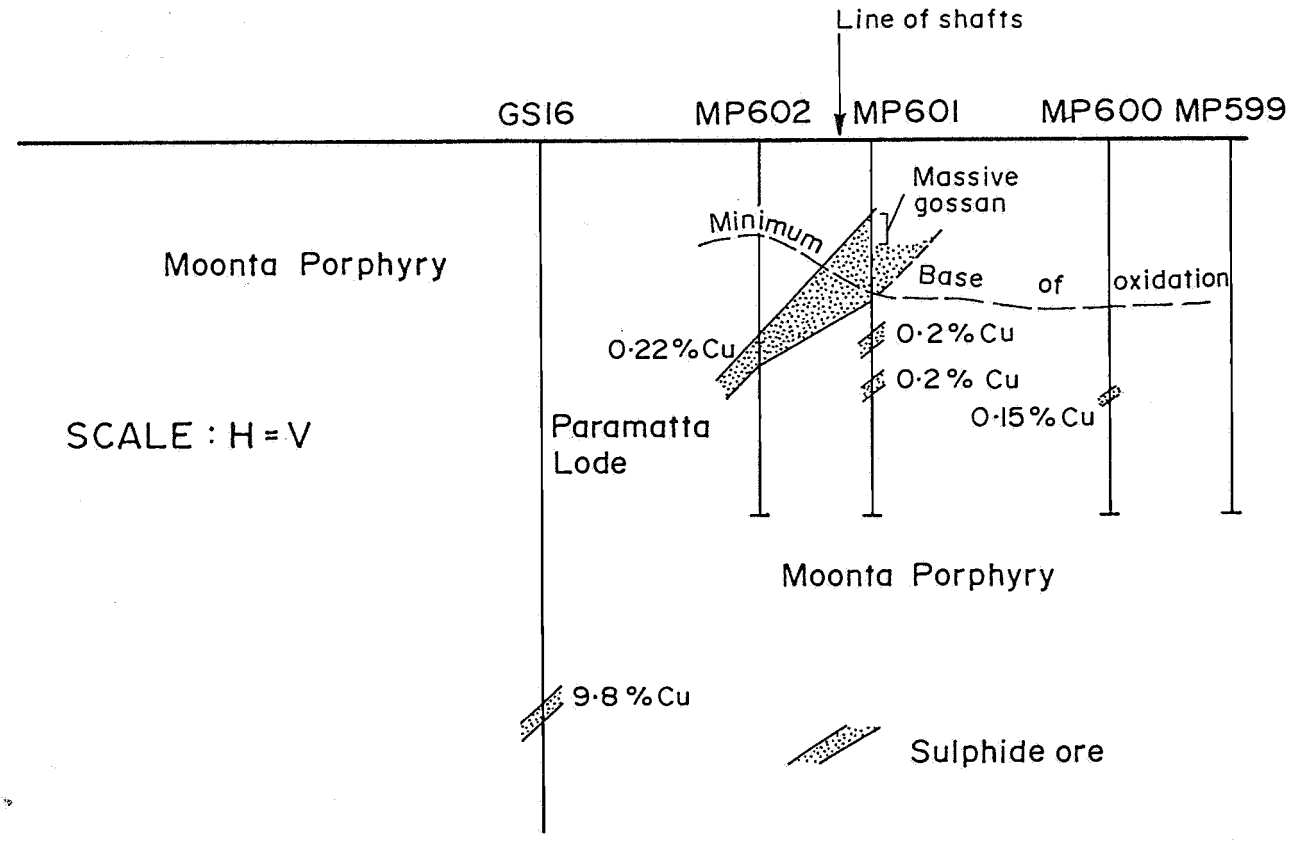

SOIL AIR CO_2 and O_2 PROJECT

MOONTA DISTRICT

PARAMATTA LODE TRAVERSE

FIG. 5

SADME 92-1097

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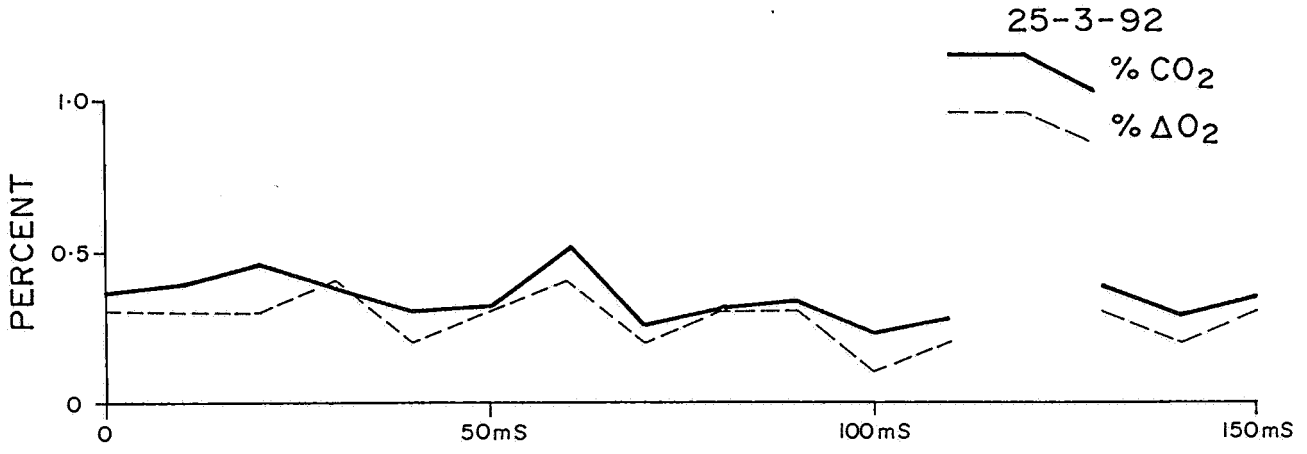

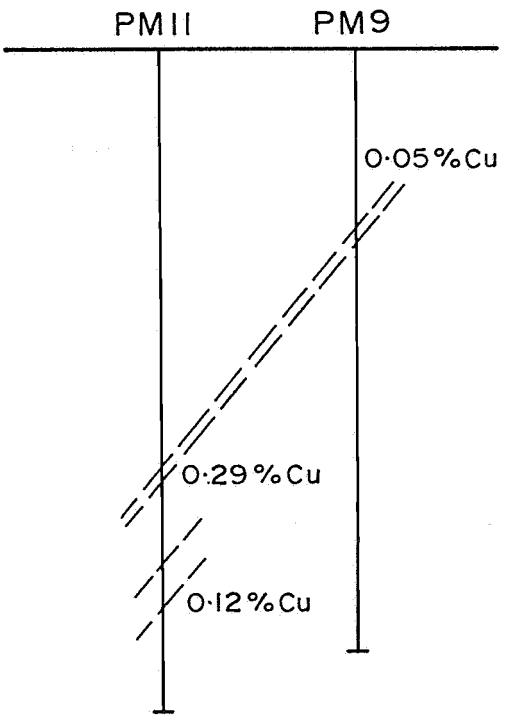

Drillhole section parallel to and 15m east of above traverse line

Chalcopyrite:pyrite ratio approx. 75:25

SOIL AIR CO_2 and O_2 PROJECT
MOONTA DISTRICT

POONA LODE TRAVERSE

FIG. 6
SADME 92-1098

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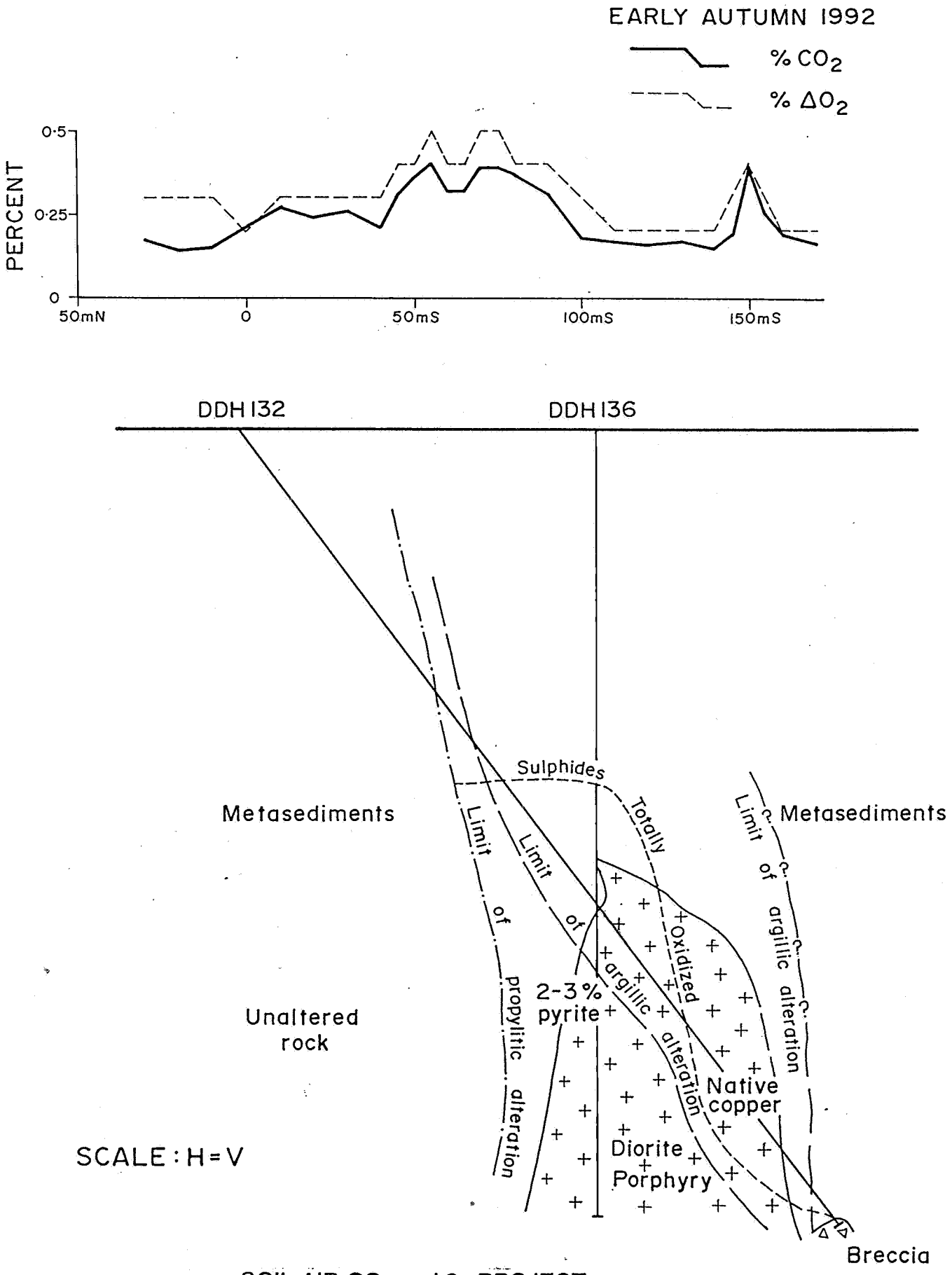

SOIL AIR CO_2 and O_2 PROJECT

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ALFORD PROSPECT TRAVERSE

FIG. 7

SADME 92-1099

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