DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPORT BOOK 91/30

WILKLOW DDH-1, NORTHWEST OF COWELL-WELL COMPLETION REPORT

by

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REGIONAL GEOLOGY BRANCH

FEBRUARY 1991

DME 152/80

D00598

CONTENTS

APPENDIX

FIGURES

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept Bk No.
DME 152/80
D00598

WILKLOW DDH-1, NORTHWEST OF COWELL - - WELL COMPLETION REPORT

ABSTRACT

Wilklow DDH-1 was drilled east of Miltalie Mine, northwest of Cowell, in order to test an IP/resistivity anomaly for lead-zinc-silver mineralisation. The hole recovered migmatitic Cook Gap Schist of the Palaeoproterozoic Hutchison Group to 152.5m. Biotite, garnet and sillimanite are prominent in the schist, which locally contains graphite, pyrite, traces of galena, and thin marble and amphibolite interbeds.

The IP/resistivity anomaly is thought to be due to graphite and possibly sulphides in greater concentrations than in Wilklow DDH-1 below or adjacent to the drillhole. This shallow-sourced anomaly could be effectively investigated by further geophysical survey lines and shallow drilling near the drillhole.

INTRODUCTION

Numerous deposits and prospects of Ag, Pb, Zn and Cu occur within the Palaeoproterozoic Hutchison Group of eastern Eyre Peninsula (Fig. 1; Johns, 1961; Townsend, 1988; Flint and Rankin, 1990), the largest being the recently-discovered Menninnie Dam prospect (Higgins and Hellsten, 1986) north of Kimba.

In order to encourage base metal exploration in South Australia, the Department established the Lead-Zinc Initiative, which included a review of lead-zinc mineralisation of the Gawler Craton (Townsend, 1988), followed by an aerial magnetic, radiometric and VLF-EM survey which was carried out over much of Eyre Peninsula in 1988. Several areas were then selected for follow-up ground geophysics and drilling. One of these areas (outside the aerial survey area) was near the Miltalie Mine northwest of Cowell (Fig. 2), exploited for Pb, Ag and Cu until 1914 and diamond drilled by the Department in 1915-16 (Johns, 1961) and 1990 (Parker, in prep.).

The current investigations comprised an IP/resistivity survey carried out in March 1990 (Figs 3 and 4; Harvey and Dodds, in prep.), followed by the drilling of three diamond holes during July-August 1990. Wilklow DDH-1 (Fig. 5), the subject of this report, was sited approximately 500 m east of Miltalie Mine to test an IP/resistivity anomaly thought to be due to disseminated sulphides in calcsilicate as at the Miltalie Mine. The property is owned by the Norris family.

REGIONAL GEOLOGY

The Palaeoproterozoic geology of the Gawler Craton in the Cleve Uplands consists of three major units: the Miltalie Gneiss; the unconformably-overlying Hutchison Group; and the younger Lincoln Complex granitoids (Parker and Lemon, 1982; Parker, 1983a, b, c; Parker *et al.*, 1985, 1988).

Miltalie Gneiss crops out in a northerly trending belt northwest of Cowell (Fig. 1) and comprises granitic and augen gneiss, migmatitic garnet gneiss and amphibolite. U-Pb geochronology has dated the metamorphism within the Miltalie Gneiss at approximately 1964 Ma (Fanning, 1987).

Mixed clastic and chemical metasediments of the Hutchison Group crop out extensively in the Cleve Uplands (Parker and Lemon, 1982). Basal Warrow Quartzite is overlain in turn by Katunga Dolomite, Lower Middleback Jaspilite, Cook Gap Schist and Upper Middleback Jaspilite (Middleback Subgroup); and by Yadnarie Schist. Warrow Quartzite comprises feldspathic and micaceous quartzite, but includes calcsilicate gneiss and marble at the base and interbedded pelitic schist at the top; it represents transgressive sedimentation onto the Sleaford Complex. Marble of the Katunga Dolomite and carbonate-, silicate- and oxide-facies iron formation of the Lower Middleback Jaspilite were deposited in deepening water. In the Miltalie-Cleve region the latter unit is relatively iron-poor and comprises grunerite schist, diopside-amphibole quartzite (with variable magnetite content) and graphitic quartzite. Biotite-muscovite-garnet schist and biotite-sillimanite-garnet gneiss of the Cook Gap Schist are interpreted as clastics deposited under regressive conditions. Concordant, tholeiitic amphibolites within this unit represent either basalt flows or sills. Quartz-grunerite-cummingtonite-magnetite gneiss, quartzite and dolomitic marble comprise the Upper Middleback Jaspilite, and the Yadnarie Schist is composed of biotite-muscovite-garnet schist. These two units were laid down during a second transgressive-regressive cycle, similar to that which generated the Lower Middleback Jaspilite and Cook Gap Schist.

Lincoln Complex granitoids were emplaced during the 1850-1700 Ma Kimban Orogeny and comprise non-foliated and mylonitic varieties (Parker, 1983b; Parker *et al.*, 1988; Flint and Rankin, 1990). The Kimban Orogeny complexly folded and metamorphosed both Hutchison Group and Miltalie Gneiss. The two major folding episodes are termed D_2 (early) and D_3 (late). Valley floors within the Cleve Uplands contain gravel, sand and clay mainly of the Pleistocene Pooraka Formation, together with Holocene talus and alluvium.

LOCAL GEOLOGY

Tightly folded (by D_2) Warrow Quartzite, Katunga Dolomite and Lower Middleback Jaspilite occur on the crest and western flank of the Coolanie Range (Fig. 2). Unfoliated to weakly foliated Lincoln Complex granitoids intrude these strata east and northeast of Miltalie Mine. According to Parker (1983b), the Morowie Fault separates this area from poorly exposed Miltalie Gneiss, with a window of Warrow Quartzite near the Miltalie Mine, to the west.

However, recent mapping by A.J. Parker (Fig. 3) and diamond drilling suggest that the schist intersected in Wilklow DDH-1 is Cook Gap Schist rather than Miltalie Gneiss as previously mapped. Consequently the Marowie Fault has been reinterpreted by A.J. Parker as passing to the west of Wilklow DDH-1, with the schist in this drillhole being stratigraphically in sequence with but overlying the succession in the Coolanie Range. Figure 2 shows the geology of the Miltalie Mine - Atkinson Mine region as reinterpreted by A.J. Parker.

Miltalie Mine occurs in a dolomite and banded diopside quartzite calcsilicate unit interpreted to be at the base of the Warrow Quartzite; this area is separated from Miltalie Gneiss to the west by a major fault which was inferred, through the drilling of Miltalie Mine DDH-4 (Parker, in prep.), immediately west of the mine.

GEOPHYSICAL SURVEYING

The Miltalie Mine IP/resistivity survey was carried out during 6-8 March 1990 and comprised an approximately east-west 1450m traverse across the mine site and two subparallel 1000m traverses 350m to the north and 500m to the south (Harvey and Dodds, in prep.; Figs 3 and 4). The survey consisted of 4-level 50m dipole-dipole readings with 250m of 25m infill over the mine site.

Wilklow DDH-1 was drilled at 775m E on line 2 in order to test a "west-dipping zone of anomalous chargeabilities associated with locally lower resistivities in an otherwise resistive environment" (Harvey and Dodds, in prep.). This response resembled that achieved over the mineralised horizon at the Miltalie Mine. The zone of high chargeability at the eastern end of line 2 is believed to be caused by graphitic quartzite within the Lower Middleback Jaspilite; graphitic rocks crop out north of the line.

DRILLING RESULTS

Drilling of Wilklow DDH-1 was carried out by Strata Exploration Pty Ltd, Dean Watts being the driller. An Explorer rig, mounted on a 6WD International truck was utilised, and drilling was undertaken from 27/7/90 to 7/8/90. Water was obtained from a local dam.

Wilklow DDH-1 intersected pale grey to grey-black migmatitic schist assigned to the Cook Gap Schist (Hutchison Group) from 7.7 to 152.5m (Figs 5 and 6). The schist is composed of quartz, microcline, plagioclase, biotite, sillimanite and pink garnet, with local blue-green aggregates of chlorite/serpentine. Migmatitic segregations varying from 1 to 15cm in width are dominantly concordant with the foliation, but are locally discordant or folded. They consist of quartz and off-white to pale green feldspar with common chlorite/serpentine clots and, in the lower parts of the hole, local garnet and graphite, and rare tourmaline.

Down to 19.05m, the schist is even-grained and banded but not strongly foliated. Below 24.35m, the schist has a well-developed but uneven and wavy foliation defined by mineralogical banding, migmatitic segregations, and alignment of biotite and sillimanite. Crenulations are notable near 30m and 38m in interpreted fold hinge zones. Below 124.6m, the schist becomes more psammitic, with finer mineralogical layering, more even foliation and finer-grained garnet. Thin interbeds of similar psammitic schist are also present above 124.6m; one of these (86.9-87.0m) is composed of plagioclase, biotite and quartz with a high apatite content. Trace graphite is present in the schist in the intervals 84-98.8m and 149.8-152.2m and blue-green chloritisation of the schist is prominent from 94.3m to 102.5m. A 3cm-wide schist band rich in biotite and garnet at 120.85m contains 5% pyrite.

The interval 11.8-19.05m contains several thin interbands of speckled white and green rock, possibly calcsilicate. Banded serpentine + chlorite + phlogopite + dolomite marble from 43.8-45.2m represents a calcareous interbed; it is flanked on both sides by altered marble and schist. Thin interbands of banded green amphibolite are present at 68.35-68.8m and between 144.8m and 145.75m. The upper amphibolite contains 1-2% pyrite and traces of pyrrhotite, chalcopyrite and marcasite. Banding within these interbands may be inherited from bedding suggesting that the amphibolite may of calcsilicate origin. It is likely that the gneissic banding and parallel foliation of the enclosing schist closely parallel primary bedding. Gneissic pegmatites occur sporadically down to 62m and range up to 5.3m in thickness. As well as quartz and cream-pink to pale green feldspar, they contain variable amounts of biotite, blue-green chlorite/serpentine clots, phlogopite + tourmaline (8.5-9.5m), graphite (35.4-36.3m; 10% graphite), and inclusions of the host schist.

Rare films of galena were noted on fractures from 75.8m to 84.8m together with traces of pyrite and ?chalcopyrite. Blebs of galena were tentatively identified in a felsic segregation at 75.9m and were noted, together with small masses of pyrite and traces of chalcopyrite and ?sphalerite, in brecciated, graphitic schist at 83.55m.

Geochemical grab sampling has revealed several anomalous values within the interval 68-87m, ranging up to 5 ppm Ag, 330 ppm Pb, 360 ppm Zn, 250 ppm Cu and 0.03 ppm Au. Four out of the five grab samples from this interval contained between 2 and 5 ppm Ag.

CONCLUSIONS AND RECOMMENDATIONS

Wilklow DDH-1 was primarily designed to test an IP/resistivity anomaly centred at 850m E on line 2 for lead-zinc sulphide mineralisation in the vicinity of Miltalie Mine. The downhole geophysical logs (Fig. 6) show several narrow intervals characterised by decreased IP resistivity and increased chargeability. One of these, at about 35.5m, corresponds to a gneissic pegmatite band which contains about 10% graphite, and another, at about 68m, reflects a thin, sulphide-bearing amphibolite band. Responses between 75m and 85m parallel the occurrences of trace galena noted in the geological log and probably indicate an interval of weak Pb mineralisation, possibly originally stratabound. Chloritised schist at about 99m may contain some finely-divided graphite, accounting for the IP-chargeability response at this depth. Downhole logs were unable to be run below 119.4m.

The surface IP/resistivity anomaly, therefore, may correspond to elevated graphite (or possibly galena) content in schist either below or adjacent to the drillhole. Because the anomaly indicates that the source comes very close to surface, and weathered rock occurs at 6.7 m vertical depth in Wilklow DDH-1, a combination of further IP/resistivity surveying followed by pattern auger or rotary drilling could effectively test extensions of this anomaly along strike.

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GEOCHEMICAL ANALYSES

Sample No. (prefix 6230 RS...)	Depth (m)
543	33.95-34.05
544	44.5-44.6
545	60.75-60.9
546	68.0-68.1
547	68.3-68.45
548	80.85-81.0
549	83.55
550	86.9-87.0
551	94.7-94.8
552	137.5-137.7
553	145.5-145.65
554	148.55-148.7

```
MAJOR ELEMENTS IN PERCENT

             6230     6230     6230     6230     6230     6230     6230     6230     6230     6230     6230     6230
              543      544      545      546      547      548      549      550      551      552      553      554

SiO2            .        .        .        .        .        .        .        .        .        .        .        .
TiO2            .        .        .        .        .        .        .        .        .        .        .        .
Al2O3           .        .        .        .        .        .        .        .        .        .        .        .
Fe2O3           .        .        .        .        .        .        .        .        .        .        .        .
FeO             .        .        .        .        .        .        .        .        .        .        .        .
MnO             .        .        .        .        .        .        .        .        .        .        .        .
MgO             .        .        .        .        .        .        .        .        .        .        .        .
CaO             .        .        .        .        .        .        .        .        .        .        .        .
Na2O            .        .        .        .        .        .        .        .        .        .        .        .
K2O             .        .        .        .        .        .        .        .        .        .        .        .
P2O5            .        .        .        .        .        .        .        .        .        .        .        .
H2O+            .        .        .        .        .        .        .        .        .        .        .        .
H2O             .        .        .        .        .        .        .        .        .        .        .        .
CO2             .        .        .        .        .        .        .        .        .        .        .        .
LOI             .        .        .        .        .        .        .        .        .        .        .        .

Total        0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00


TRACE ELEMENTS IN PPM

Ag          -1.00    -1.00    -1.00     5.00     2.00    -1.00     2.00     2.00    -1.00     2.00    -1.00    -1.00
As          20.00    10.00    20.00    10.00     5.00    20.00    10.00    15.00    15.00     5.00    10.00    20.00
Au           0.01     0.03     0.01    -0.01    -0.01    -0.01    -0.01     0.02     0.01        .        .        .
B               .        .        .        .        .        .        .        .        .        .        .        .
Ba              .        .        .        .        .        .        .        .        .        .        .        .
Bi              .        .        .        .        .        .        .        .        .        .        .        .
Cd          -5.00    -5.00    -5.00    -5.00    -5.00    -5.00    -5.00    -5.00    -5.00    -5.00    -5.00    -5.00
Ce              .        .        .        .        .        .        .        .        .        .        .        .
Co          15.00     5.00     5.00    10.00    45.00    10.00    70.00    25.00    15.00    30.00    30.00    15.00
Cr          65.00    10.00    30.00    25.00      100    65.00    65.00    20.00    50.00    55.00    40.00    70.00
Cs              .        .        .        .        .        .        .        .        .        .        .        .
Cu          70.00    -5.00     5.00    15.00      250    55.00    65.00    45.00      120      120    20.00    10.00
Fe          56000     6900    19400    110E3    113E3    41000    137E3    74000    68000    81000    78000    37000
La              .        .        .        .        .        .        .        .        .        .        .        .
Mn            310      390      130    18800     2900      680      840      940     2900     4700     1650      660
Mo          10.00    -5.00    10.00    10.00    -5.00    10.00     5.00     5.00     5.00    -5.00    -5.00    -5.00
Nb              .        .        .        .        .        .        .        .        .        .        .        .
Ni          35.00     5.00    10.00    10.00    60.00    25.00      120    25.00    40.00    40.00    15.00    30.00
Pb            -10    10.00    40.00      -10      -10      120      330      120    20.00    35.00      -10      -10
Rb              .        .        .        .        .        .        .        .        .        .        .        .
Sb              .        .        .        .        .        .        .        .        .        .        .        .
Sn          -4.00    -4.00     4.00    -4.00    10.00    -4.00     6.00    -4.00    -4.00     5.00    -4.00     6.00
Sr              .        .        .        .        .        .        .        .        .        .        .        .
Th          24.00     4.00    18.00    18.00    -4.00    14.00    20.00      105    22.00    20.00    -4.00    16.00
U           -4.00    -4.00    -4.00    -4.00     5.00     5.00    -4.00    14.00     4.00    -4.00     5.00     5.00
V           80.00    10.00    30.00    60.00      430    80.00      100      110    75.00    80.00      250    65.00
W             -10      -10      -10      -10      -10      -10      -10      -10      -10    10.00      -10      -10
Y               .        .        .        .        .        .        .        .        .        .        .        .
Zn            120    40.00    40.00      130      190      360    60.00      170      120      110      130    85.00
Zr              .        .        .        .        .        .        .        .        .        .        .        .

( Negative values indicate < ie. less than,      . = Not Analysed,      @ = PPB,     % = % )
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MAGNETIC SUSCEPTIBILITY RESULTS

Z. Shi, University of Adelaide

Table 4: Drilling Information and Magnetic Susceptibility Measurements of Cores in Eyre Peninsula

Hole	RS	Depth	Lithology	Magnetic Susceptibility			
Wilklow	6030RS	(m)		RDG $SI \times 10^{-5}$	Size and C. L.	Factor	Corrected κ $SI \times 10^{-5}$
DDH-1	543	33.95-34.05	feld+quartz+bio+ sillim gneiss	20-25	$\frac{5}{8}$core 12cm	2.0	40-50
	544	44.5-44.6	altered forsterite+ phlogopite marble	600-950	$\frac{3}{4}$core 9cm	2	1200-1900
	545	60.75-60.9	feld +quartz+ bio+sillim gneiss	10-20	$\frac{1}{2}$core 11cm	2.5	25-50
	546	68-68.1	quartz+bio+garnet gneiss	70	$\frac{7}{8}$core 16cm	1.5	105
	547	68.3-68.45	amphibolite	75	$\frac{3}{4}$core 15cm	2	150
	548	80.85-81	quartz+feld+bio+ chlorite gneiss	10-15	$\frac{1}{2}$core 10cm	2.5	25-40
	549	83.55	pyritic quartz+feld +chlorite+graphite gneiss	15	$\frac{1}{2}$core 4.cm	3.75	56
	550	86.9-87.0	feld +bio+quartz gneiss	35	$\frac{1}{2}$core 15cm	2.5	84
	551	94.7-94.8	chloritised feld+ quartz+bio gneiss	25-30	$\frac{3}{4}$core 9cm	2	50-60
	552	137.5-137.7	quartz+garnet+ bio+feld gneiss				
	553	145.5-145.65	amphibolite				
	554	148.55-148.7	feld+quartz+bio sillim gneiss				

Zhiqun Shi
Department of Geology and Geophysics
University of Adelaide

Notation:

Size: Core Size
C.L.: Core length (cm)
RDG: Readings from Susceptibility Meter, the values are mean or typical range.
Lithology identification by W. Cowley SADME

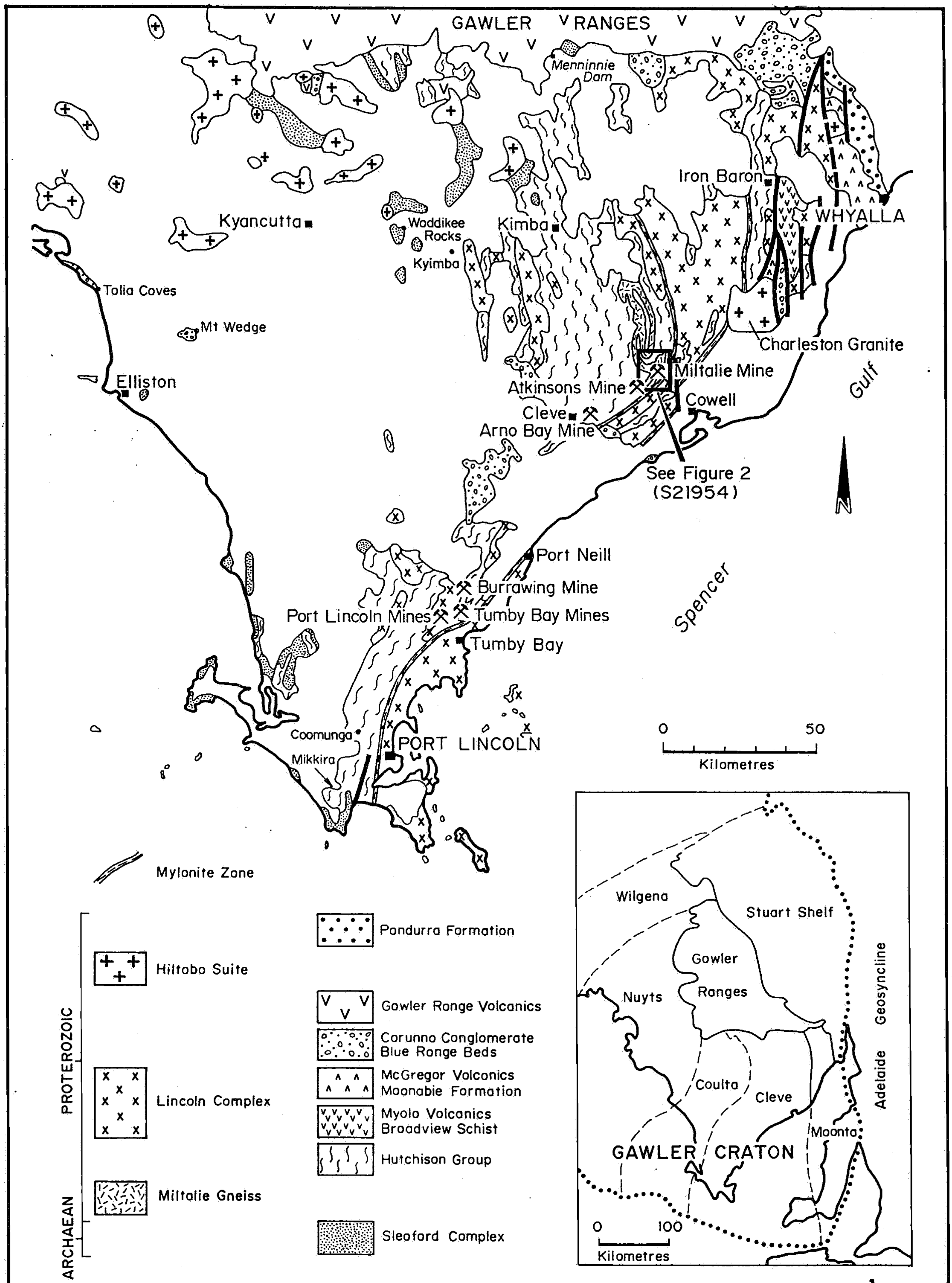


Figure.....1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

WILKLOW DDH-1 WELL COMPLETION REPORT

REGIONAL GEOLOGY AND LOCATION PLAN

COMPILED
W. Cowley

25·2·91
C.D.O. DATE

DRAWN
R. Bird

SCALE As shown

DATE
February 1991

CHECKED

PLAN NUMBER
S21953

5236

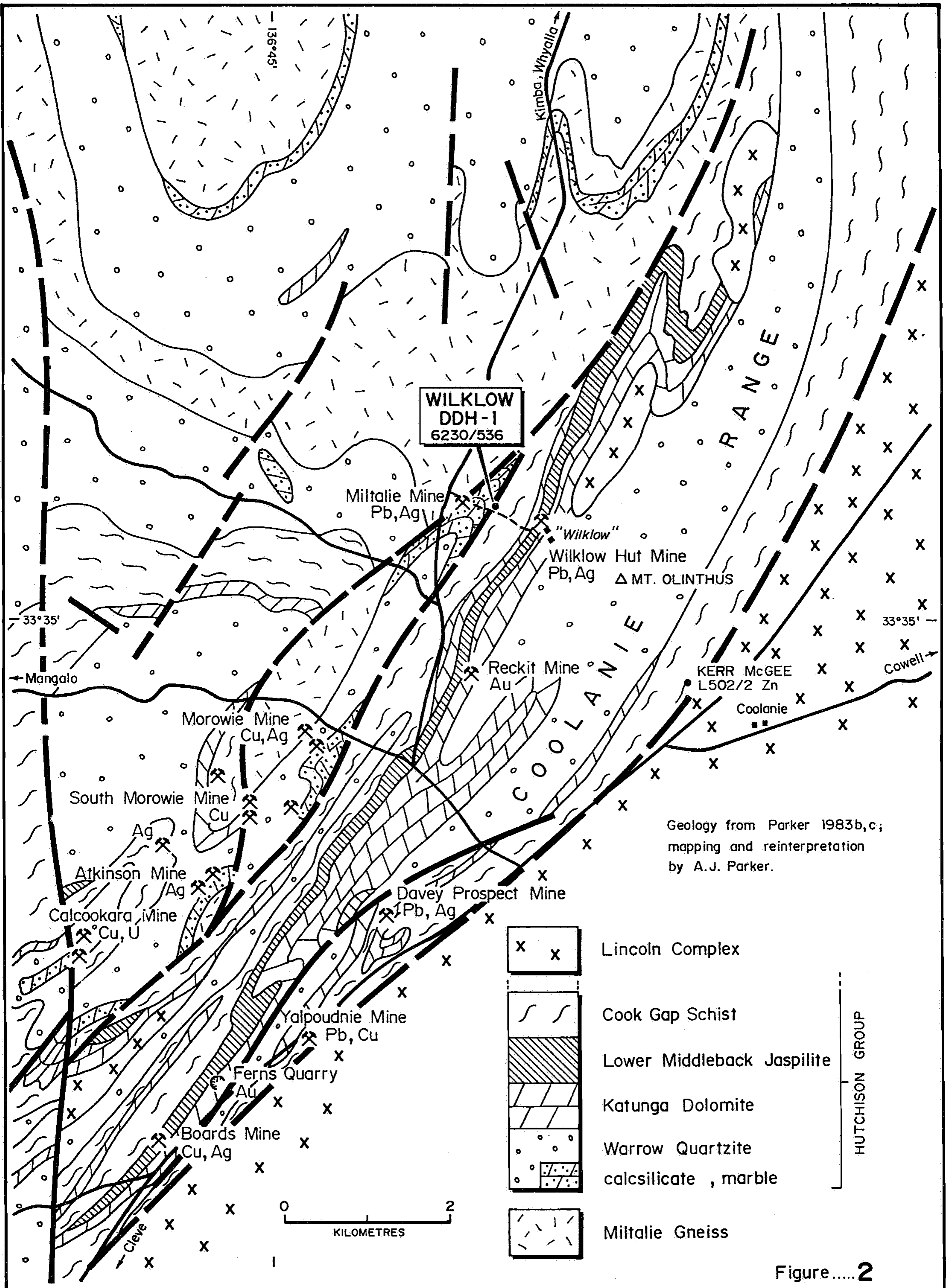


Figure.....2

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

WILKLOW DDH-1 WELL COMPLETION REPORT

GEOLOGY OF MILTALIE MINE REGION

COMPILED W. Cowley	C.D.O.	DATE 25·2·91.
DRAWN R. Bird	SCALE 1:40 000	
DATE February 1991	PLAN NUMBER S21954	
CHECKED		

5236

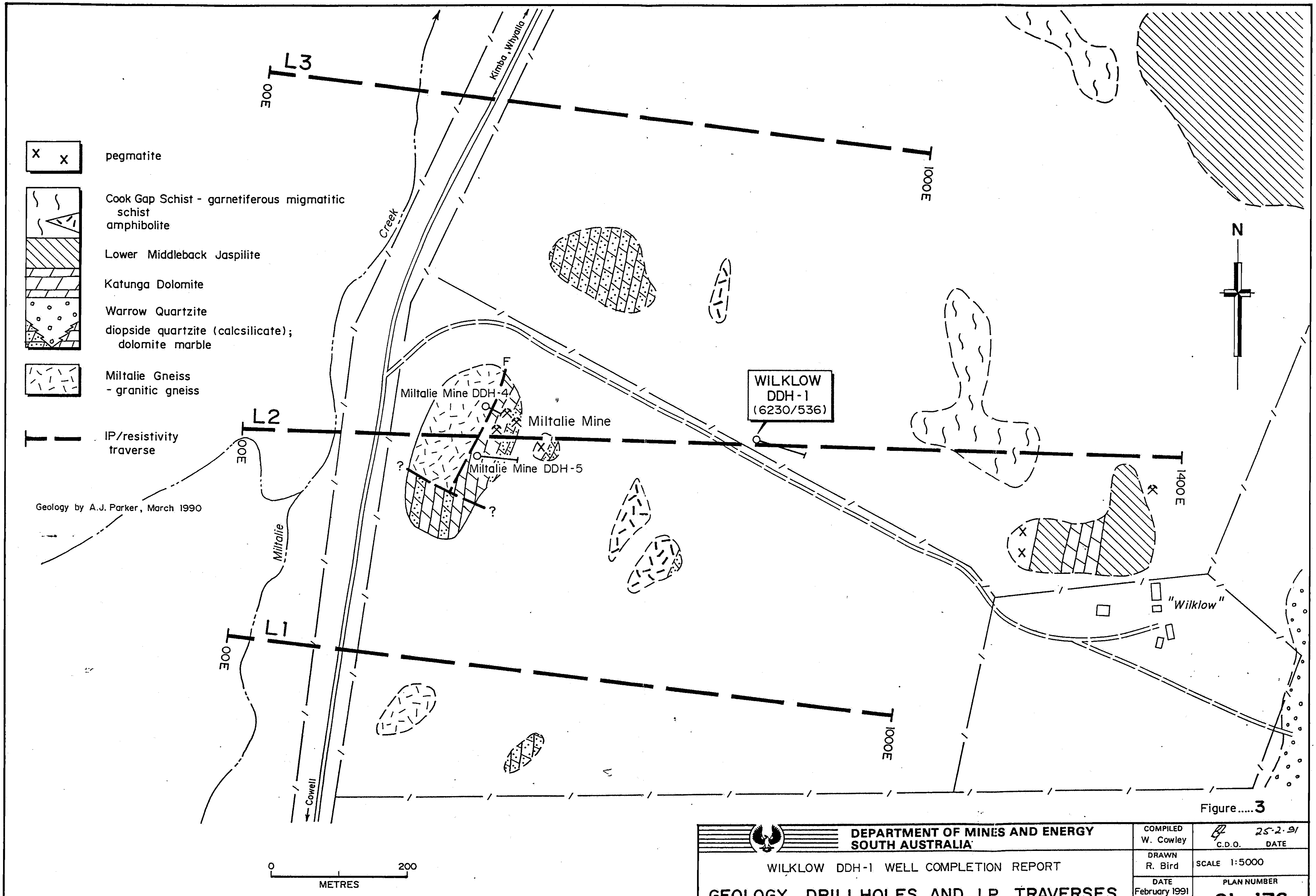


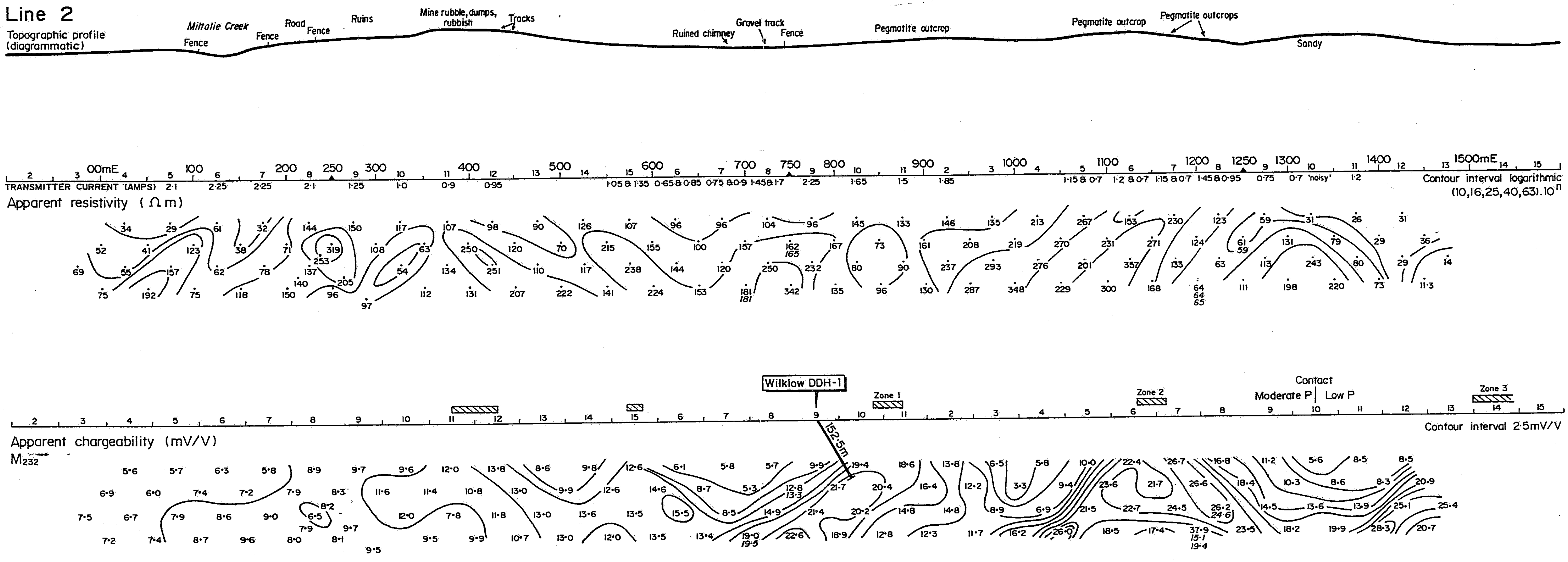
Figure.....3

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

WILKLOW DDH-1 WELL COMPLETION REPORT

GEOLOGY, DRILLHOLES AND I.P. TRAVERSES

COMPILED W. Cowley	C.D.O.	DATE 25-2-91
DRAWN R. Bird	SCALE 1:5000	
DATE February 1991	PLAN NUMBER 91-176	
CHECKED		



Dipole size ....50 m

Setup point shown.........▲

IP anomaly............... ▨

Compiled by S. Dodds, Geophysicist, S. A. Dept of Mines and Energy

Figure.....4

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

WILKLOW DDH-1 WELL COMPLETION REPORT

INDUCED POLARISATION / RESISTIVITY PROFILE, LINE 2

COMPILED W. Cowley	C.D.O.	25-2-91 DATE	
DRAWN R. Bird	SCALE As shown		
DATE February 1991	PLAN NUMBER		
CHECKED	91 - 177		

5236

DEPARTMENT OF MINES AND ENERGY—SOUTH AUSTRALIA

Wilklow DDH-1

6230001MW00536

CORE DESCRIPTION

DEPTH 152·5m

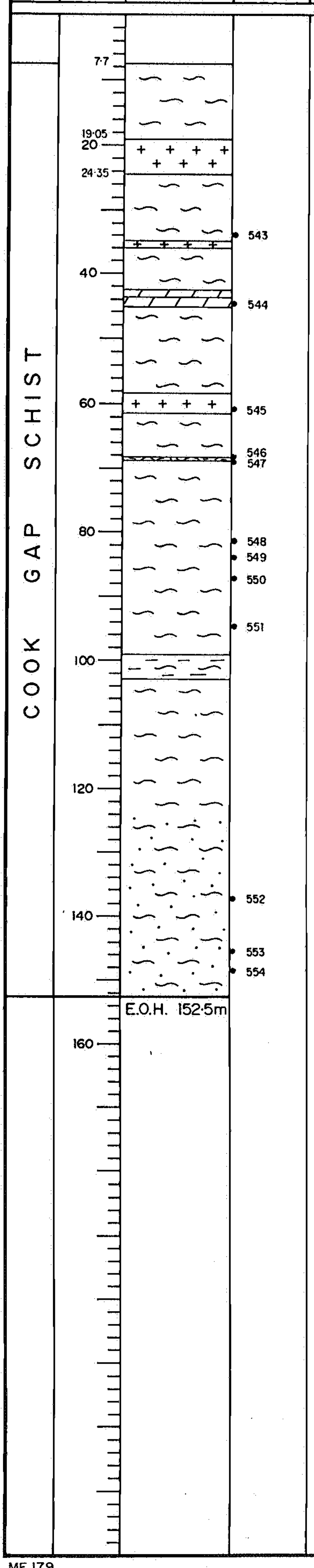
INCLINATION 60° → 102° mag

LOGGED BY W. M. Cowley

DATE DRILLED 27/7/90-7/8/90

REFERENCE

DEPTH (m) | GRAPHIC LOG | ROCK SAMPLE prefix 6230RS | DESCRIPTION



No core

Dark grey, m.g., even-grained QUARTZ + FELDSPAR + BIOTITE + SILLIMANITE SCHIST. Gneissic pegmatite bands. Minor green-white ? calcsilicate bands.

Very coarse QUARTZ + FELDSPAR + BIOTITE + GNEISSIC PEGMATITE

Banded and well-foliated, MIGMATITIC QUARTZ + MICROCLINE + PLAGIOCLASE + BIOTITE + SILLIMANITE + GARNET SCHIST, becoming more psammitic and finely layered below 124·6m Traces graphite and pyrite below 66m. Rare galena 75·8 - 98·8m. Locally chloritised.

35·4 - 36·3m GRAPHITIC, FELDSPAR + BIOTITE / CHLORITE PEGMATITE.

42·2 - 43·8m Mottled, blue-green and white ALTERED DOLOMITIC MARBLE.

43·8 - 45·2m Green and white, banded SERPENTINE + PHLOGOPITE DOLOMITIC MARBLE.

58·1 - 61·35m QUARTZ + FELDSPAR GNEISSIC PEGMATITE; minor chlorite + biotite schist.

68·35 - 68·8m Dark green, finely banded and foliated AMPHIBOLITE.

98·8 - 102·5m Broken, chloritised, clayey

150m Eastman camera survey : 58·5° → 108° mag.

Figure.....5

SHEET..1..OF..1...

PLAN Nº S21955

5236

MF 179

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA
REGIONAL GEOLOGY BRANCH

WILKLOW DDH-1
COMPOSITE WELL LOG

PROJECT DETAILS

UNIT No 6230001MW00536
LOCATION SECTION 43 , HUNDRED OF MILTALIE
665150 mE , 6284000 mN , Zone 53
DATUM 1·55 m ABOVE GROUND LEVEL
LOGGED BY W. COWLEY DATE AUG. - SEPT. 1990

GEOPHYSICAL LOGS

TYPE OF LOG	GAMMA	NEUTRON	SUSCEPTIBILITY	IP RESISTIVITY	CHARGEABILITY
DATE OF RUN	9/8/90				
RECORDED BY	N.C. Taylor				
FIRST READING (m)	119·41	119·41	119·41	119·41	119·41
LAST READING (m)	0	3	16	11	11

LITHOLOGY

UNIT

DESCRIPTION

COOK GAP SCHIST

0 - 7·7 m No Core

7·7 - 8·5 m Weathered, m.g., even-grained, dark grey QUARTZ + FELDSPAR + BIOTITE + SILLIMANITE SCHIST. Gneissic pegmatite 7·7 - 7·8 m

8·5 - 9·5 m QUARTZ + FELDSPAR + BIOTITE + pale brown ? PHLOGOPITE + TOURMALINE GNEISSIC PEGMATITE. Schist inclusions with garnet

9·5 - 11·8 m Dark grey, banded, QUARTZ + FELDSPAR + BIOTITE + SILLIMANITE ± GARNET SCHIST. Migmatitic segregations to 2cm wide Synclinal fold near bottom.

11·8 - 12·2 m Even-grained, m.g., speckled green and white clayey rock, possibly CALCSILICATE.

12·2 - 13·4 m Very coarse, QUARTZ + FELDSPAR + BIOTITE GNEISSIC PEGMATITE. Feldspar is creamy pink or pale green. Schist inclusions.

13·4 - 16·9 m Dark grey, m.g., even-grained, QUARTZ + FELDSPAR + BIOTITE + SILLIMANITE SCHIST.

15·6 - 16·0 m Weathered, m.g., pale green and white ? CALCSILICATE band

16·9 - 19·05 m Interlayered m.g., even-grained, dark grey to green grey QUARTZ + FELDSPAR + BIOTITE + SILLIMANTE + ? SERICITE SCHIST, and weathered green-white ? CALCSILICATE ROCK. Intermediate lithologies present.

19·05 - 24·35 m Very coarse (grain size to 10cm) QUARTZ + FELDSPAR + BIOTITE GNEISSIC PEGMATITE.

20·1 - 20·2 m Inclusion of schist
20·6 - 20·75 m Inclusion of ? calcsilicate rock.
24·3 - 24·35 m Clots of blue-green chlorite/serpentine.
24·35 m End of strongly broken core.

24·35 - 35·4 m Distinctly banded and well-foliated, QUARTZ + FELDSPAR + BIOTITE + knotted SILLIMANITE + pink GARNET SCHIST, with numerous migmatitic segregations with blue-green CHLORITE/SERPENTINE. Segregations mostly near concordant, locally discordant, occasionally folded

28·8 - 30·1 m Synformal fold, schist crenulated in axis

32·95 m Blebs of graphite in segregation.

35·4 - 36·3 m Coarse, grey-white FELDSPAR + GRAPHITE (~10%) + BIOTITE/CHLORITE PEGMATITE. Schist inclusions. Whitish QUARTZ + FELDSPAR PEGMATITE 36·1 - 36·3 m.

36·3 - 36·6 m Mottled, weakly banded rock composed of grey-white FELDSPAR, blue-green CHLORITE/SERPENTINE, silvery-green ? CHLORITE and pale, dull green ? DIOPSIDE. Contains 1 - 2% GRAPHITE

36·6 - 42·2 m Banded, foliated, slightly migmatitic QUARTZ + FELDSPAR + BIOTITE + SILLIMANITE + GARNET SCHIST as 24·35 - 35·4 m. Soapy white clay or green ? chlorite on fractures.

37·5 - 38·1 m Crenulated schistosity grading into antiformal fold at bottom
41·0 m Schist becoming more psammitic

42·2 - 43·8 m Mottled, light to dark blue-green and white rock, probably altered DOLOMITIC MARBLE as below. Vague relict banding. Gradational lower contact.

43·8 - 45·2 m Green and white SERPENTINE + CHLORITE + PHLOGOPITE + DOLOMITE MARBLE with distinct banding reflecting bedding, parallel to foliation in schist. Phlogopite confined to discrete lenses.

45·2 - 45·75 m Mottled QUARTZ + ? FELDSPAR + CALCITE + CHLORITE/SERPENTINE ROCK with relict banding Possibly altered migmatitic segregation.

45·75 - 58·1 m Grey QUARTZ + FELDSPAR + BIOTITE + SILLIMANITE MIGMATITIC SCHIST as 24·35 - 35·4 m. Felsic segregations mostly ~1cm thick, with prominent clots of chlorite/serpentine, which also occurs locally as small lenses in schist.

45·75 - 50·0 m Slightly more pelitic, with garnet.
51·45 - 51·6 m 10cm band of v.f.g. grey pelitic rock without foliation or obvious quartz.
51·6 - 53·9 m Felsic segregations abundant, locally 70% of core.
56·65 - 57·1 m Quartz + creamy-pink to pale green feldspar vein.

58·1 - 58·7 m Grey-white to green, QUARTZ + FELDSPAR GNEISSIC PEGMATITE. Feldspar greenish to cream. Inclusions of biotite + chlorite.

58·7 - 59·3 m Fine grained, dark green-grey, banded but weakly foliated CHLORITE + BIOTITE SCHIST.

59·3 - 61·35 m QUARTZ + green-cream FELDSPAR GNEISSIC PEGMATITE as 58·1 - 58·7 m.

60·2 - 61·3 m Much core loss; inclusion of schist

61·35 - 61·8 m Dark grey green, weakly foliated PSAMMITIC SCHIST. Includes 20cm interval of biotite + sillimanite schist.

61·8 - 67·5 m Grey QUARTZ + FELDSPAR + BIOTITE - SILLIMANITE MIGMATITIC SCHIST as 45·75 - 58·1 m Felsic segregations cream to greenish, mostly 1-5 cm wide, coarse-grained.

62·15 - 62·6 m Felsic segregation
65·2 - 65·4 m Conformable band of dark green-grey, fine-grained micaceous quartzite, weak foliation.
66·5 - 66·7 m Trace pyrite, chalcopyrite in felsic segregation.
66·9 m Graphite aggregates in felsic segregation adjacent to fold.

67·5 - 68·0 m Coarse QUARTZ + FELDSPAR + BIOTITE SCHIST, with feldspar porphyroblasts to 1cm. Includes concordant felsic segregation with garnet.

68·0 - 68·35 m Greenish grey QUARTZ + BIOTITE + GARNET + CHLORITE SCHIST. Disseminated pyrite ~1 %. Abrupt, conformable lower contact.

68·35 - 68·8 m Dark green, well-foliated AMPHIBOLITE, consisting of hornblende, biotite, chlorite, muscovite/sericite and quartz. 1-2% pyrite aggregates in upper part, trace pyrrhotite, chalcopyrite, marcasite

68·8 - 98·8 m Grey-black QUARTZ + FELDSPAR + BIOTITE + GARNET MIGMATITIC SCHIST, with wavy foliation. Graphitic below 84 m. Chlorite/serpentine and trace pyrite and graphite in felsic segregations below 75·5 m.

68·9 m Garnet in felsic segregation.
69·6 - 70·0 m Fine-grained quartz + feldspar + biotite schist.
70·0 - 71·1 m Common subhedral cream feldspar porphyroblasts and coarse-grained segregations with local tourmaline
75·8 m ? Galena film on fracture.
75·9 m Blebs of ? galena in felsic segregation.
77·7 - 78·9 m Scattered pyrite and ? galena on fractures
78·9 m Grey clay in fracture at 20° to core axis: possible fault.
78·9 - 98·8 m Trace pyrite and ? chalcopyrite on fractures and locally disseminated in schist. Trace ? galena on fractures down to 84·8 m.
83·5 m Masses of pyrite in brecciated zone with chlorite and graphite and trace ? galena.
84·0 - 98·8 m Traces of graphite in schist.
84·6 - 84·75 m Chloritised, brecciated.
85·8 - 86·2 m Dark red-grey, f.g., plagioclase - biotite - quartz schist.
86·9 - 87·0 m Faintly banded, f.g., plagioclase - biotite - quartz schist with considerable apatite.
94·3 - 98·8 m Blue-green chlorite alteration in schist, more common chlorite/serpentine in felsic segregations.

98·8 - 102·5 m Green-grey QUARTZ + BIOTITE + CHLORITE + FELDSPAR + GARNET SCHIST. Broken, clay alteration. Chloritised.

102·5 - 124·6 m Dark to light grey, QUARTZ + FELDSPAR + BIOTITE + GARNET ± SILLIMANITE MIGMATITIC SCHIST. Foliation usually wavy and irregular, but schist is locally fine-grained, with finer, planar layering. Garnet up to 8mm, smaller in finer-grained sections. Felsic segregations up to 15cm wide, with garnet, common feldspar porphyroblasts and chlorite/serpentine and local pyrite. Gradational lower boundary.

105·8 - 106·3 m Chlorite alteration of biotite.
108·25 - 111·8 m Common finely-layered schist.

111·8 - 119·7 m Broken, clayey, chlorite-altered, trace pyrite.

120·85 m 5% pyrite in 3cm band rich in garnet and biotite.
121·2 - 122·9 m Trace graphite accompanies pyrite in felsic segregations.

124·6 - 152·5 m Dark to light grey QUARTZ + FELDSPAR + BIOTITE ± SILLIMANITE ± GARNET MIGMATITIC SCHIST, as 102·5 - 124·6 m, but more psammitic, less sillimanite and garnet, finer garnet (≤2mm) and layering finer. Local graphite blebs in felsic segregations.

123·7 - 124·8 m Trace graphite and pyrite in felsic segregations.
128·0 m Minor pyrite in 3cm wide green chloritic band.
131·35 - 135·6 m Scattered traces graphite in felsic segregations, local folds.

136·55 - 144·8 m Local blebs of graphite to 2mm in felsic segregations.
138·1 - 138·4 m Minor pyrite in felsic segregations with garnet

144·8 - 145·0 m Banded, garnetiferous amphibolite
145·1 - 145·25 m Pegmatitic quartz + feldspar + biotite segregation.
145·45 - 145·75 m Dark green, foliated amphibolite composed of hornblende, biotite, tremolite/actinolite, and sericite-altered ? plagioclase, with minor clinopyroxene, garnet and quartz. Interbanded with biotite + sillimanite schist.

150·0 m Eastman camera survey : 58·5° → 108° magnetic.
151·1 m Blebs of graphite to 2mm in 2cm-wide felsic segregation. Schist either side has trace graphite and coarser garnets for 30 cm.
151·4 - 152·2 m Disseminated graphite in schist (<<1%) and in coarse felsic segregations. Trace pyrite.

END OF HOLE 152·5 m

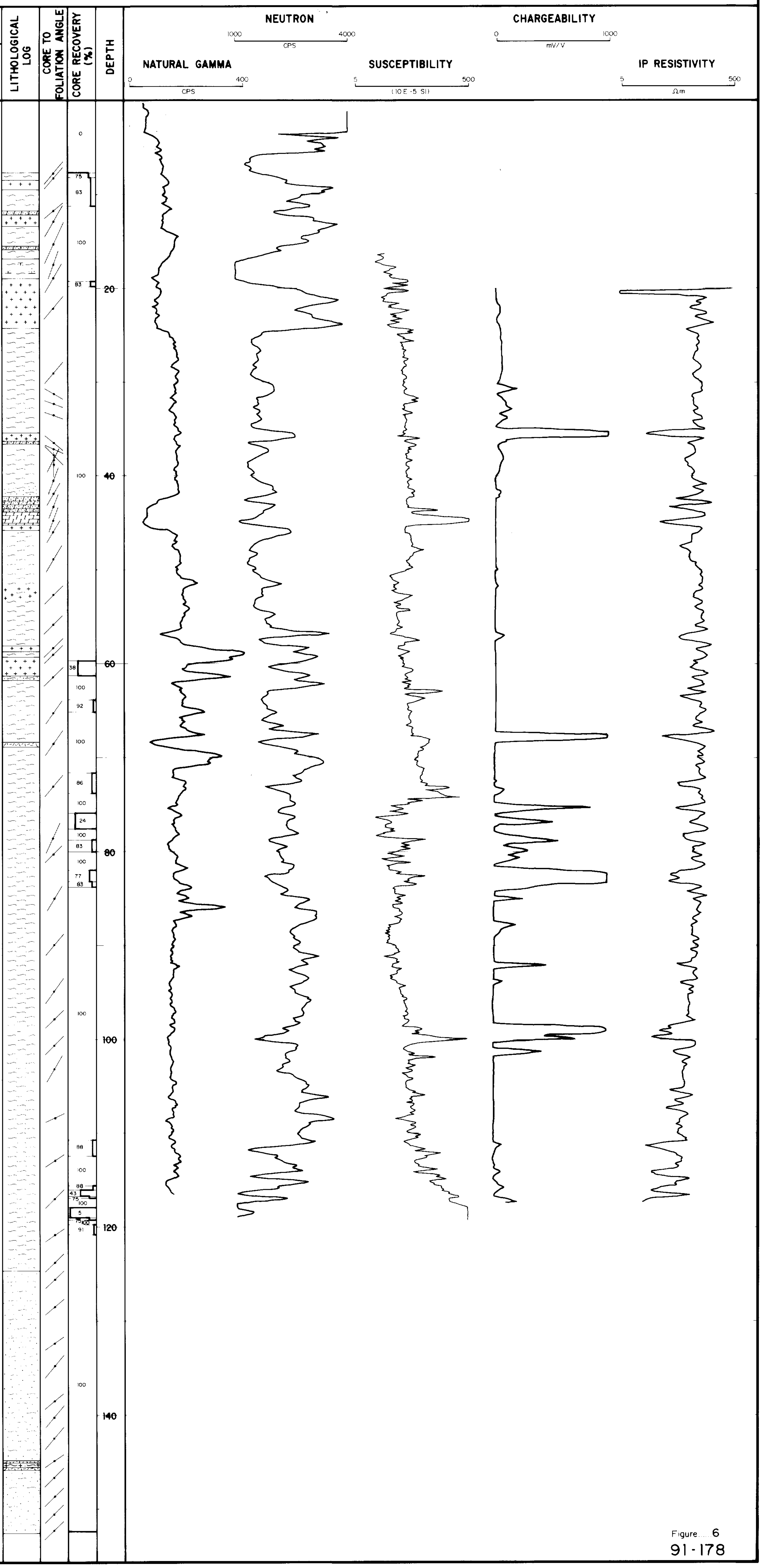


Figure 6
91-178

WAYNE COWLEY
REGIONAL GEOLOGY

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WAYNE COWLEY
~~Ms. Soula Tyrteos~~
S.A. Dept. of Mines & Energy
PO Box 151
EASTWOOD
SA 5063

Willcox DDH-1

FINAL ANALYSIS REPORT

Your Order No: EX-1040/12/07/0024 Our Job Number : 0AD2914

Samples received : 10-SEP-1990 Results reported : 10-OCT-1990
No. of samples : 9
Report comprises a cover sheet and pages 1 to 4

This report relates specifically to the samples tested in so far as that the samples as supplied are truly representative of the sample source.

Note:
If you have any enquiries please contact Miss Anne Reed quoting the above job number.

Approved Signatory:

John Waters
Technical Manager - Adelaide

CC ~~Ms Soula Tyrteos~~ Eastwood
MM ~~Ms Soula Tyrteos~~ Eastwood

Report Codes:		Distribution Codes:	
N.A.	- Not Analysed.	CC	- Carbon Copy
L.N.R.	- Listed But Not Received.	EM	- Electronic Media
I.S.	- Insuffecent Sample.	MM	- Magnetic Media

"RELIABLE ANALYSES AT COMPETITIVE COST"

CLASSIC LABORATORIES LTD

Job: 0AD2914
O/N: EX-1040/12/07/0024

ANALYTICAL REPORT

	Sample	WillowDDH-7	Ag	As	Cd	Co	Cr	Cu	Fe
schist	6230RS543	33.95-34.05	<1	20	<5	15	65	70	5.60%
serp-phlog marble	6230RS544	44.5-44.6	<1	10	<5	5	10	<5	6900
foliated pegmatite	6230RS545	60.75-60.9	<1	20	<5	5	30	5	1.94%
pyritic ?calc silicate sch	6230RS546	68.0-68.1	5	10	<5	10	25	15	11.0%
?amphibolite	6230RS547	68.35-68.45	2	5	<5	45	100	250	11.3%
schist	6230RS548	80.85-81	<1	20	<5	10	65	55	4.10%
pyritic schist	6230RS549	83.55	2	10	<5	70	65	65	13.7%
?bio qtzt	6230RS550	86.9-87	2	15	<5	25	20	45	7.40%
chloritised sch.	6230RS551	94.7-94.8	<1	15	<5	15	50	120	6.80%
	Units		ppm	ppm	ppm	ppm	ppm	ppm	ppm
	DL		1	5	5	5	5	5	100
	Scheme		ICP2	ICP2	ICP2	ICP2	ICP2	ICP2	ICP2

Job: 0AD2914
O/N: EX-1040/12/07/0024

ANALYTICAL REPORT

Sample	Mn	Mo	Ni	Pb	V	Zn
6230RS543	310	10	35	<10	80	120
6230RS544	390	<5	5	10	10	40
6230RS545	130	10	10	40	30	40
6230RS546	1.88%	10	10	<10	60	130
6230RS547	2900	<5	60	<10	430	190
6230RS548	680	10	25	120	80	360
6230RS549	840	5	120	330	100	60
6230RS550	940	5	25	120	110	170
6230RS551	2900	5	40	20	75	120
Units	ppm	ppm	ppm	ppm	ppm	ppm
DL	10	5	5	10	5	5
Scheme	ICP2	ICP2	ICP2	ICP2	ICP2	ICP2

Job: 0AD2914
O/N: EX-1040/12/07/0024

ANALYTICAL REPORT

Sample	Au Avg	Au	Au Rp1	Au SS1
6230RS543	0.01	0.01	--	0.01
6230RS544	0.03	0.03	--	--
6230RS545	0.01	0.01	--	--
6230RS546	<0.01	<0.01	--	--
6230RS547	<0.01	<0.01	--	--
6230RS548	<0.01	<0.01	--	--
6230RS549	<0.01	<0.01	--	--
6230RS550	0.02	0.02	--	--
6230RS551	0.01	0.01	--	--
Units	ppm	ppm	ppm	ppm
DL	0.01	0.01	0.01	0.01
Scheme	FA1	FA1	FA1	FA1

Job: 0AD2914

ANALYTICAL REPORT

O/N: EX-1040/12/07/0024

Sample	Sn	Th	U	W
6230RS543	<4	24	<4	<10
6230RS544	<4	4	<4	<10
6230RS545	4	18	<4	<10
6230RS546	<4	18	<4	<10
6230RS547	10	<4	5	<10
6230RS548	<4	14	5	<10
6230RS549	6	20	<4	<10
6230RS550	<4	105	14	<10
6230RS551	<4	22	4	<10
Units	ppm	ppm	ppm	ppm
DL	4	4	4	10
Scheme	XRF1	XRF1	XRF1	XRF1