DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 87/133

PT. GAWLER 3 WELL COMPLETION REPORT AND REVISION OF THE GEOLOGY AROUND PORT GAWLER

GEOLOGICAL SURVEY

by

A.P. BELPERIO
REGIONAL GEOLOGY

DECEMBER, 1987

DME.337/76

CONTENTS

APPENDICES

FIGURES

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT. BK. NO. 87/133
DME. NO. 337/76
DISK NO. 17

PORT GAWLER 3 WELL COMPLETION REPORT AND REVISION OF THE GEOLOGY AROUND PORT GAWLER

ABSTRACT

The South Australian Department of Mines and Energy drillhole, Port Gawler 3, is located at Port Gawler beach, on the shore of Gulf St Vincent. Rotary drilling established 312 m of weakly consolidated Cainozoic (Middle Eocene - Recent) sediments of the St Vincent Basin overlying unweathered Precambrian bedrock. Diamond drilling with full core recovery revealed ABC Range Quartzite (312 - 587 m) conformably overlying finer-grained Brachina Formation (587 - 682 m). Together with former seismic coverage, the drillhole has permitted re-interpretation of the bedrock structure and topography. The perceived limit of subsurface Cambrian strata is more restricted than previously believed and a relatively complete Adelaidean succession is thought to underlie the region. Eocene palaeochannels are preferentially entrenched into more easily erodible Brachina Formation and are infilled with fluvial sands (North Maslin Sand) and marginal-marine, tidal channel sands (South Maslin Sand).

INTRODUCTION

Port Gawler 3 was drilled in the St Vincent Basin, an intracratonic Cainozoic structure developed on Cambrian (Stansbury Basin) and Adelaidean (Adelaide Geosyncline) strata (Fig. 1). The drillhole is located 10 km west of Virginia at Port Gawler beach on the eastern shore of Gulf St Vincent. The drillsite is composed of low, unconsolidated, shellgrit ridges, and surrounded by intertidal sandflat and supratidal marsh sediments of the Holocene St Kilda Formation (Belperio, 1987). The final site selected was 2 km north of the Departmental drillholes, Port Gawler Observation Bore F and Port Gawler Observation Bore FR, at the end of the Port Gawler causeway (Fig. 2).

The purpose of the drillhole, initially to be also sited at the end of the causeway, was to provide stratigraphic information on Cambrian and Adelaidean strata concealed beneath Cainozoic sediments of the northern Adelaide Plains to a depth of approximately 1000 m. Dolomites of possible Cambrian age were previously encountered at the base of Port Gawler Observation Bore F (Lindsay, 1965), and confirmation of a thick Cambrian section would extend the known limits of the Stansbury Basin. The anticipated sequence at the end of the causeway, based largely on interpretation of seismic line SV78G1, was:

unconsolidated Cainozoic	0 - 350 m
Cambrian carbonates	350 - 540 m
Adelaidean quartzite, shale	540 - 1100 m

Magnetic basement was interpreted at either 2100 m (Hartman, 1965) or about 1100 m (Department of Mines and Energy, 1981) below an incomplete lower Adelaidean sequence.

Following a site inspection with M. Brennan of the Drilling Branch in July 1986, the proposed drillhole was shifted 2 km northwards to Port Gawler beach because of perceived access and drilling problems at the original site. As a result, the carbonates sampled in Port Gawler Observation Bore F were not encountered in Port Gawler 3, presumably due to their updip termination.

The new site, provided additional structural data for a regional re-interpretation of Cainozoic and bedrock geology. The sequence encountered at Port Gawler 3 was:

unconsolidated Cainozoic	0 - 312 m
ABC Range Quartzite	312 - 587
Brachina Formation	587 - 682

Drilling did not reach target depth because extremely hard drilling conditions in the ABC Range Quartzite resulted in slower than anticipated progress and excessive bit wear. The approved budget of $120,000 was overspent by $8163.

SUMMARY OF WELL AND DRILLING DATA

Well Name: Port Gawler 3
Docket: 337/76
Unit No: 6528160SW01100
Bore Serial No: 2/87 and 57/87
Permit No: 94701
Debit No: 136-F94
Map Sheets: ADELAIDE 1:250 000 SI 54 - 9
Vincent 1: 50 000 6528-1

Location: Hundred of Port Gawler, Section 687
Latitude 34°39'15"S
Longitude 138°26'43"E

Elevation: Ground Level estimated at 3 m AHD.
Drilling depths and core logs measured from ground level

National Parks Permit No: A05472
Rotary Drilling commenced: 30-7-86
Rotary Drilling ceased: 14-8-86
Diamond Drilling commenced: 29-10-86
Diamond Drilling ceased: 6-3-87
Status: Converted to Water Level Observation Well

Drilling Contractor: South Australian Department of Mines and Energy, Dalgleish St., Thebarton S.A. 5031
Drilling history is summarised on Fig. 3.

Precollar Drilling: Portadrill RD2, Driller L. Moore
Commenced 30-7-86 from ground level
Completed 14-8-86 to 318 m

The well was collared with 203 mm ID PVC pipe set at 6 metres and drilled 200 mm diameter to 40 m. A string of 152 mm ID S+S medium black pipe was run to 39.23 m and the shoe was cemented. The 152 mm ID steel cased off very saline water in sands and gravels which would have collapsed had loss of circulation occurred while drilling. Drilling continued 152 mm

diameter to 313.5 metres into hard quartzite. Quartzite was first encountered at 312.2 m. A bottom hole core was cut using an oversize HQ diamond bit. The core was cut from 313.5 m - 315.5 m, recovery was 100% of fractured quartzite. After coring a roller bit was run to ream the cored section to 152 mm and while reaming the bit broke into quartzite rubble so drilling was continued into solid quartzite at 318 m. After electric logging, a string of 100 mm HD screwed and socketed pipe was run to 318 m and pressure cemented with 85 sacks of cement. Mud returns were lost during displacement and cement did not return to the surface. Additional cement was placed in the annulus from the surface. Taper-taper sockets were used on the last 100 m of pipe run in the casing string. A drillable cement plug was run between the cement and the displacement water. The well was capped and enclosed within a man proof fence to await diamond drilling. A seawater mud system was used at the commencement of drilling, using water from a pit dug in the shellgrit ridge and blending with Geofluids Salt Vis. Although proving satisfactory initially, all viscosity disappeared after two shifts drilling, and it was necessary to revert to a fresh water, bentonite mud system to complete the well. Fresh water was obtained from Buckland Park.

Diamond Drilling: Longyear 44 diamond drill rig No. 1, Driller F. Costello.
Commenced 29-10-86 from 318 m.
Completed 6-3-87 to 681.97 m.

HQ wireline coring from 318 m to 522.35 m, drilled 204.35 m, core recovered 204.35 m. Used HQ rods as casing to 520.80 m and reduced to NQ wireline coring from 522.35 to completed depth of 681.97 m, drilled NQ 159.62 m, core recovered 159.62 m.
Total combined coring HQ and NQ from 318 m to 681.97 m, drilled 363.97 m, core recovered 363.97 m (100%). Drilling was slow due to the very hard and broken quartzite and was extremely hard on coring bits. Mostly impregnated bits were used and on two occasions the bit manufacturers were called to the site to try to improve the cutting performance, but to little avail. A total of 31 bits were used to drill 363.97 m; average 11.74 m per bit at a cost of $52 per metre for bits. On completion of drilling,

tropari tests were undertaken using 2 instruments but trouble was encountered. The tropari's, at times would not lock, and gave different readings at the same check depths. Therefore when the hole was geophysically logged, a deviation probe was run. On completion of logging, Groundwater and Engineering Branch requested various aquifer tests. Permit number 94701 was alloted, and cement plugging selected areas and geophysicaly perforating the aquifers through the cemented 104 mm diameter steel pipe were performed as below:

Cement plug from 291 m to 400 m.
30 sacks cement 1,112 litres cement slurry pumped through NQ rods from 400 m.
Perforate from 276.4 m to 278, 5 charges
Section flowing after shoot 0.25 L/sec.
" " next day 0.75 L/sec.
Check rise above ground level through NQ rod attached to 100 mm NB pipe; rose to 9.20 m above ground.
2 bottles water samples taken.
Cement plug from 210 m to 290 m.
20 sacks cement 743 litres cement slurry pumped through NQ rods from 291 m.
Perforate from 196.4 m to 198 m, 5 charges.
Airlift with compressor at 110 m, no water , seepage only.
Water level next day 89 m. (2 bottles water samples taken). Cement plug from 183 m to 205 m.
6 sacks cement 210 litres cement slurry, dump bailed HQ 183 m to 205 m.
Perforate from 196.4 m to 198 m, 5 charges.
Airlift with compressor at 110 m, no water, seepage only.
Water level next day 89 m. (2 bottles water samples taken).
Cement plug from 183 to 205 m.
6 sacks cement 210 litres cement slurry, dump bailed HQ 183 m to 205 m.
Perforate from 162 m to 164 m, 5 charges.
Airlift from 110 m through 3/4" polypipe 0.25 L/sec/
Recover 38 minutes, level 66.9 m.
" 2 hours " 64.00 m.
2 water samples taken.

The hole was capped with 100 mm NB screw-on cap on pipe at surface and left for observation purposes for Groundwater and Engineering Branch.

Formation Sampling: Rotary sludge samples, surface to 313 m at 4.57 m intervals.
: Rotary bottomhole core 313.3 - 315.3 m
: Continuous diamond coring 318 to 522.35 m (HQ size)
: Continuous diamond coring 522.35 to 681.97 m (NQ size
: Core recovery 100%. All core and cuttings stored at SADME Core Library.

Hole Deviation: by tropari at 600 m, 650 m, 680 m; results unreliable.
: by deviation survey from 450 to 655 m; indicating average deviation of 1° towards 300°.

Core Orientation: undertaken at 650.35 m, 659.93 m, 662.25 m and 666.67 m by spear method; indicating mean strata dip 30° towards 270°.

Geophysical Logging Surveys: by SADME Geophysics Branch.

Log	Date Run	Interval	SADME Log Index	Datum A.G.L.
Caliper	7/8/86	0-312 m	4090	1.75 m
Long Density	"	"	4090	"
Neutron	"	"	4090	"
Resistance	"	"	4090	"
Gamma	"	"	4089	"
S.P.	"	"	4089	"
Neutron	12/12/86	290-520 m	4200	1.25 m
Gamma	"	"	"	"
Resistance	"	"	"	"
S.P.	"	"	"	"
Caliper	"	"	4201	"
Long Density	"	"	"	"
Short Spaced Density	"	"	"	"
Gamma	27/2/87	450-682 m	4343	1.61 m

Neutron	"	"	4343	"
S.P.	"	"	4343	"
Resistance	"	"	4343	"
Long Density	"	"	4344	"
Short Spaced Density	"	"	4344	"
Caliper	"	"	4344	"
Hole Direction	"	"	4344	"

LITHOLOGY AND STRATIGRAPHY

The stratigraphic sequence penetrated in Port Gawler 3 is summarised in Fig. 4 and detailed core and cuttings descriptions are given in Appendix 1. Composite well logs with interpreted formations for the Cainozoic and Adelaidean strata are presented as Figures 5 and 6 respectively. Depths to formation tops were selected after consideration of lithological and all geophysical logging data. These are summarised below:

Unit	Interval(m)	Thickness(m)
St. Kilda Formation	0 - 2.5	2.5
Pooraka Formation	2.5 - 5.0	2.5
Glanville Formation	5.0 - 6.5	1.5
Unnamed Clays	6.5 - 10.0	3.5
Older Pleistocene Marine Beds	10.0 - 12.0	2.0
Hindmarsh Clay	12.0 - 67.5	55.5
Burnham Limestone	67.5 - 69.5	2.0
Carisbrooke Sand	69.5 - 73.0	3.5
Hallett Cove Sandstone	73.0 - 73.5	0.5
Dry Creek Sands	73.5 - 97.0	23.5
Port Willunga Formation	97.0 - 222.0	125.0
- (Ruwarung Member	167.0 - 197.0	30.0)
- (Aldinga Member	197.0 - 222.0	25.0)
Chinaman Gully Formation	222.0 - 226.0	4.0
Blanche Point Formation	226.0 - 261.0	35.0
South Maslin Sand	261.0 - 290.0	29.0
Clinton Formation	290.0 - 312.2	22.2
ABC Range Quartzite	312.2 - 587.0	274.8*
Brachina Formation	587.0 - 682.2+	95.2**

Total thickness penetrated: 682.2 m

* True thickness of ABC Range Quartzite: 238 m +

** True thickness of Brachina Formation: 82 m +

St Kilda Formation (Qhk)

Light grey, unconsolidated shelly sand with abundant molluscan, foraminiferal and algal detritus. Age 7 000 years B.P. to the present. Holocene marine and marginal-marine sediments. The upper surface of the St Kilda Formation is not confined, but is a surface of active sedimentation (Cann and Gostin, 1985; Belperio, 1985a,b; Belperio et al., 1986).

Pooraka Formation (Qpp)

Red-brown and yellowish-brown, micaceous sandy clay. Late Pleistocene alluvial flood plain unit deposited as a result of fluvial resurgence during the last glacial maximum approximately 30,000 to 20,000 years B.P. (Firman, 1966; Williams, 1969).

Glanville Formation (Qpg)

Pale-brown to yellow-brown, clayey shelly sand and shelly limestone (Firman, 1966; Ludbrook, 1976; Cann, 1978; Belperio, 1985b). Veneered by a thin, laminar, vadose calcrete crust (Bakara Calcrete of Daily et al., 1976), and contains numerous lime-cemented lumps, but otherwise loose and friable. A marine and coastal-marine unit deposited during a high sea level period associated with the Last Interglacial, approximately 110,000 years B.P. (Belperio et al., 1984). Contains elements of a warmer-water fauna that are no longer living in local waters (Howchin, 1888, 1923).

Unnamed Clays

Yellow-brown and reddish-brown, poorly-sorted sandy clay. Fluvial facies of Late Pleistocene age constrained by overlying and underlying marine strata.

Older Pleistocene Marine beds

Pale-orange to yellowish-orange, well-cemented, mixed skeletal and quartz sandstone. A marine and coastal-marine unit deposited during the Penultimate Interglacial high sea level stand (Hails et al., 1984) and dated at 200,000 ± 50 years B.P. (Murray-Wallace et al., 1987).

Hindmarsh Clay (Qph)

Mottled, red-brown and yellow-brown micaceous clay and sandy clay with sand and gravel lenses (Firman, 1966). Piedmont fan, distal alluvial fan, fluvial and continental lacustrine deposits of Early to Late Pleistocene age (1.8 - 0.2 Ma). Pedogenic

processes have caused mottling, carbonate segregation, incipient calcretization and Red-Brown Earth profile development within and at the surface of this unit.

Burnham Limestone equivalent (Qpr)

Pale-orange, fossiliferous sandstone with a calcareous micritic matrix. Fossiliferous marine sediment at the base of the Hindmarsh Clay of Late Pliocene to Early Pleistocene age (Firman, 1976).

Carisbrooke Sand (Qpc)

Mottled, poorly-sorted, weakly ferruginous and calcareous sandy clay and clayey quartz sand. Sandy fluviatile deposits of Late Pliocene to Early Pleistocene age (Lindsay, 1969).

Hallett Cove Sandstone (Tp)

White and yellowish - orange, well-cemented, fossiliferous, calcareous, micritic sandstone. Marine and coastal-marine sediment of Late Pliocene age (Ludbrook, 1963; Lindsay, 1969; Daily et al., 1976).

Dry Creek Sands (Tp)

Yellowish - brown to light-grey, shelly silty sand. Abundant molluscan, bryozoal and foraminiferal detritus. Interbeds of cemented calcareous sandstone. Marine and coastal-marine sediment of Late Pliocene age (Ludbrook, 1963; Lindsay, 1969; Daily et al., 1976).

Port Willunga Formation (Tmp)

White to light-grey, bryozoal limestone, foraminiferal and echinoid calcarenite, and glauconitic marl. Age Late Eocene to Middle Miocene. A thick sequence of various transgressive and regressive marine deposits (Lindsay, 1969). Oligocene Ruwarung Member is characterised by alternating silicified bands and nodular silicification (Cooper, 1985; Lindsay 1969; 1985). Late Eocene Aldinga Member is characterised by pyritic, organic and glauconitic, bioturbated mudstones and is difficult to distinguish from underlying Chinaman Gully Formation.

Chinaman Gully Formation (Teg)

Black, pyritic and organic, micaceous mudstone with minor bioturbation. A Late Eocene, regressive, marginal-marine unit (Cooper, 1985; Lindsay, 1985).

Blanche Point Formation (Teb)

Light-grey and green-grey, sandy glauconitic limestone and grey, bioturbated, carbonaceous mudstone. Abundant siliceous sponge spicules and silicified interbeds (Gull Rock Member). Age Late Eocene. Marine deposition in a low-energy, muddy marine environment with poorly oxygenated bottom (Daily et al., 1976) with a significant volcanic ash component (Jones and Fitzgerald, 1986). Increasingly glauconitic towards the base where it cannot be differentiated lithologically from possible Tortachilla Limestone (Lindsay, 1969).

South Maslin Sand (Tes)

Olive-black, poorly sorted, carbonaceous fine sand. Abundant pyrite and poorly fossiliferous. Thin interbeds of muddy skeletal limestone and micaceous mudstone. Age Middle to Late Eocene (Daily et al., 1976). Intertidal to shallow-subtidal arenaceous deposits.

Clinton Formation (Tec)

Dark-brown to black, carbonaceous clay, lignite and pyritic silty sand. Marginal-marine and terrestrial swamp deposits of Middle to Late Eocene age (Harris, 1966).

ABC Range Quartzite (Pwa)

White to light-grey, dense, fine-grained quartzite with thin mud drapes, mud laminae and mud intraclasts. Interbedded grey-green and red-brown micaceous mudstone. Flaser, tabular and trough crossbedding and lateral accretion co-sets. Clastic-dominated shallow-marine and intertidal sedimentation of Late Adelaidean (Marinoan) age. Together with the underlying Brachina Formation, comprises a coarsening and shallowing-upward, regressive cycle (Preiss and Forbes, 1981). The drillcore represents approximately the lower half of this formation.

Brachina Formation (Pwr)

Interbedded grey-black, sandy muddy siltstone, silty mudstone and poorly-sorted, gritty, pelletal sandstone. Variably oxidised to red-brown. Uppermost part only of this Formation is represented in the core. Planar to low-angle crossbedding occurs in fining-upwards cycles on a decimetre scale. Stacking of beds with or without mud drapes and mudstone interbeds has produced sand bodies 2 to 4 m thick. By analogy with outcrop south of

Adelaide (Dyson and Von der Borch, 1986) these are interpreted as stacked, hummocky cross-stratified sand bodies. A shallow-marine, shelf deposit of Late Adelaidean (676 ± 204 Ma) age (Preiss and Forbes, 1981).

CHEMICAL ANALYSES AND PETROGRAPHY

Fifteen samples of Cainozoic sediments representing the main stratigraphic units were submitted to AMDEL for pulverising and analysis. Requested were acid evolved CO_2, total carbon by LECO combustion, phosphate analysis by acid digestion and ICP determination, and preparation of X-ray diffractometry charts. Results of phosphate, carbon and carbonate analyses are listed in Appendix 2 (AMDEL Report AC 3253/87). Semi-quantitative mineralogies calculated from relative heights of principal diffraction peaks, are listed in Appendix 3. A diagrammatic representation of the results is presented in Fig. 7. Carbonate content, as evidenced by both acid digestion and XRD results, is highest in the Blanche Point Formation and in the upper half of the Port Willunga Formation (Fig. 7) and comprise a variable mixture of aragonite, calcite and dolomite (Appendix 3). The Middle to Late Eocene sequence (200-312 m) is characterised by the presence of well-crystallised clinoptilolite, an indicator of volcanogenic input (Jones and Fitzgerald, 1984, 1986). Organic carbon content is highest in the carbonaceous Clinton Formation and generally decreases in abundance up the sequence (Fig. 7). Phosphate is enriched in the regressive, Late Eocene Chinaman Gully Formation and basal Port Willunga Formation.

Twenty samples (quarter core) from the ABC Range Quartzite and Brachina Formation were submitted to AMDEL for thin sectioning, petrography and geochemical analysis. Geochemical results (AMDEL Report AC 3254/87) are listed in Appendix 4. Petrographic descriptions (Report G 7017/87) make up Appendix 5. Finely-disseminated pyrite and pyrite spheroids, sometimes concentrated into sedimentary layers, are abundant throughout the sequence. Chloritic grains and pellets of ?faecal origin are more abundant in the finer-grained Brachina Formation. There is some potential for syn-sedimentary mineralisation as evidenced by anomalous Cu values (0.02 to 0.15%) associated with both arenaceous and argillaceous beds. No detectable gold was recorded.

SUBSURFACE GEOLOGY ABOUT PORT GAWLER 3

Belperio and Bateman (1986) compiled thickness and structure contour data on the Cainozoic beneath the northern Adelaide Plains. Depths to bedrock also were collated from drillhole, seismic and gravity data and Eocene palaeodrainage systems were inferred from the bedrock structure contours (Fig. 8 of Belperio and Bateman). SADME seismic lines in the vicinity of Port Gawler are shown on Fig. 8. These were re-interpreted after drilling and a more accurate bedrock contour map constructed using the following velocity intervals (modified from Cockshell 1980, 1983):

Q	1880 m/s
Tp	1950 "
Tmp	2015 "
Teg	2080 "
Teb	2100 "
Tes	2120 "
Tec/Ten	2200 "
B c	2500 "

Examples of interpretation of high resolution seismic lines SV78G1 and SV78G2 are presented in Figures 9 and 10. Bedrock structures are discernible including the Buckland Fault. For the Cainozoic, unconformities at the top and base of the Pliocene provide clear reflectors, as do the Chinaman Gully Formation and carbonaceous strata of the Clinton Formation and within the South Maslin Sands.

Cambrian carbonates present at the base of Port Gawler Observation Bore F are interpreted as terminating updip approximately mid-way between Port Gawler F and Port Gawler 3. This change in subcrop geology corresponds with a break in basement slope (Fig. 8), the more resistant quartzites forming a ridge (and a gravity high) rising eastwards towards the Buckland Fault. Core orientation measurements indicate a consistent dip of 30° towards 270° for both the ABC Range Quartzite and Brachina Formation in Port Gawler 3. This is corroborated by seismic reflection profiles. The Buckland Fault is down-thrown on its eastern side and is interpreted as a splinter fault on SV78G2. Although conformable in Port Gawler 3, the Brachina Formation is believed to be faulted against ABC Range Quartzite along the

Buckland Fault. To the east of the fault, the more weathered and easily erodible Brachina Formation resulted in greater entrenchment of Eocene palaeochannels (Fig. 11) and preferential accumulation of fluvial North Maslin Sand and tidal-channel South Maslin Sand (Fig. 10). The seismic reflection profiles also provide clear evidence of interdigitation of carbonaceous Clinton Formation with the arenaceous South Maslin Sand.

Although the Buckland Fault has no surface expression, correlation between boreholes implies differential subsidence and resultant minor offsetting of Tertiary units in the subsurface (Fig. 12). The Munno Para Clay Member of the Port Willunga Formation (Tmpm) was not recognised in Port Gawler 3, and its absence is thought due to erosion prior to Pliocene sedimentation.

Because a thick, Late Adelaidean sequence was encountered in Port Gawler 3, it is considered unlikely that the aeromagnetic anomaly previously noted at about 1100 m represents Archaean basement. Magnetic basement is believed to be at least at 2100 m below a probably complete, though not excessively thick, Adelaidean sequence.

SUMMARY

The drilling of Port Gawler 3 has aided the elucidation of Tertiary, Cambrian and Precambrian stratigraphy and structure in the subsurface about Port Gawler. It has negated previous interpretations of widespread Cambrian in the subsurface to the north of Port Gawler and has provided evidence that a complete Adelaidean stratigraphy underlies the St Vincent Basin.

The drillhole penetrated 312 m of weakly consolidated Cainozoic sediments, 275 m of Late Adelaidean ABC Range Quartzite, and 95 m of uppermost Brachina Formation. The Adelaidean strata contain abundant sulphide (pyrite) and have anomalous copper contents (to 0.15%). Eocene sediments are carbonaceous, record elevated phosphate values, and contain abundant clinoptilolite, a zeolite derived from alteration of volcanic ash. Pliocene to Eocene carbonate sediments are a variable mixture of calcite, dolomite and aragonite bioclasts.

REFERENCES

Belperio, A.P., 1985a. Quaternary geology of the Sandy Point and Outer Harbor - St Kilda areas, Gulf St Vincent. Q. geol. Notes, geol. Surv. S. Aust., 96:2-6.

Belperio, A.P., 1985b. The Quaternary stratigraphy between St Kilda and Outer Harbor with special reference to excavation conditions in Barker Inlet. S. Aust. Dept. Mines and Energy Rept. Bk. 85/2 (unpublished).

Belperio, A.P., 1987. Vincent map sheet 1:50 000 Geological series. S. Aust. Dept. Mines and Energy.

Belperio, A.P. and Bateman, J.M., 1986. Cainozoic stratigraphy and structure of the Gawler and Vincent 1:50 000 map sheet areas. S. Aust. Dept. Mines and Energy, Rept. Bk. 86/49 (unpublished).

Belperio, A.P., Cann, J.H. and Gostin, V.A., 1986. Quaternary stratigraphy and coastal sedimentary environments, northeastern Gulf St Vincent, South Australia. In: Parker, A.J. (compiler), One Day Geological Excursions of the Adelaide Region. Geol. Soc. Aust., S.A. Div., Adelaide, pp. 83-98.

Belperio, A.P., Smith, B.W., Polach, H.A., Nittrouer, C.A., De Master, D.J., Prescott, J.R., Hails, J.R. and Gostin, V.A., 1984. Chronological studies of the Quaternary marine sediments of northern Spencer Gulf, South Australia. Marine Geology, 61:256-296.

Cann, J.H., 1978. An exposed reference section for the Glanville Formation. Q. geol. Notes, geol. Surv. S. Aust., 65:2 - 4.

Cann, J.H. and Gostin, V.A., 1985. Coastal sedimentary facies and foraminiferal biofacies of the St. Kilda Formation at Port Gawler, South Australia. Trans. R. Soc. S. Aust., 109:121 - 142.

Cockshell, C.D., 1980. Northern Adelaide Plains underground gas storage study, Two Wells area. S. Aust. Dept. Mines and Energy, Rept. Bk. 80/90 (unpublished).

Cockshell, C.D., 1983. Northern Adelaide Plains gas storage study, Port Gawler area. S. Aust. Dept. Mines and Energy, Rept. Bk. 82/87 (unpublished).

Cooper, B.J., 1985. The Cainozoic St Vincent Basin - tectonics structure, stratigraphy. Spec. Publ. S. Aust. Dept. Mines and Energy, 5:35-49.

Daily, B., Firman, J.B., Forbes, B.G. and Lindsay, J.M., 1976. Geology, In: Twidale, C.R., Tyler M.J. and Webb B.P. (Eds), Natural History of the Adelaide Region. R. Soc. S. Aust., Adelaide, pp. 5-42.

Department of Mines and Energy, 1981. Interpreted Depths to Magnetic Basement Map, 1:1 000 000 scale. S. Aust. Dept. Mines and Energy.

Dyson, I.A. and Von der Borch, C.C., 1986. A field guide to the geology of the late Precambrian Wilpena Group, Hallett Cove, South Australia. In: Parker, A.J. (compiler), One Day Geological Excursions of the Adelaide Region. Geol. Soc. Aust., S.A. Div., Adelaide, pp. 17-40.

Firman, J.B., 1966. Stratigraphic units of Late Cainozoic age in the Adelaide Plains Basin, South Australia. Q. geol. Notes, geol. Surv. S. Aust., 17: 6-9.

Firman, J.B., 1976. Limestone at the base of the Pleistocene sequence in South Australia. Q. geol. Notes, geol. Surv. S. Aust., 58:2-5.

Hails, J.R., Belperio, A.P. and Gostin, V.A., 1984. Quaternary sea levels, northern Spencer Gulf, Australia. Marine Geology, 61:373-389.

Harris, W.K., 1966. New and redefined names in South Australian Lower Tertiary stratigraphy. Q. geol. Notes, geol. Surv. S. Aust., 20:1 - 3.

Hartman, R.R., 1965. Interpretation report of airborne magnetometer survey over St Vincent's Gulf and Investigator Strait, South Australia, for Beach Petroleum N.L. South Australian Department of Mines and Energy, Open File Envelope 482 (unpublished).

Howchin, W., 1888. Remarks on a geological section at the New Graving Dock, Glanville, with special reference to a supposed old land surface now below sea level. Trans. R. Soc. S. Aust., 10:31 - 35.

Howchin, W., 1923. The recent extinction of certain marine animals of the southern coast of Australia, together with other facts that are suggestive of a change in climate. Rep. Aust. Assoc. Adv. Sci., 16:94-101.

Jones, J.B. and Fitzgerald, M.J., 1984. Extensive volcanism associated with the separation of Australia and Antarctica. Science, 226: 346-348.

Jones, J.B. and Fitzgerald, M.J., 1986. Silica-rich layering at Blanche Point, South Australia. Aust. J. Earth Sci., 33:529 - 551.

Lindsay, J.M., 1965. Stratigraphy and micropalaeontology of three deep bores, Hundred of Port Gawler. S. Aust. Dept. Mines Rept. Bk. 60/51 (unpublished).

Lindsay, J.M., 1969. Cainozoic foraminifera and stratigraphy of the Adelaide Plains sub-basin, South Australia. Bull. geol. Surv. S. Aust., 42.

Lindsay, J.M., 1985. Aspects of South Australian Tertiary foraminiferal biostratigraphy, with emphasis on studies of Massilina and Subbotina. Spec. Publ. S. Aust. Dept. Mines and Energy, 5:187 - 231.

Ludbrook, N.H., 1963. Correlation of the Tertiary rocks of South Australia. Trans. R. Soc. S. Aust., 87: 5-15.

Ludbrook, N.H., 1976. The Glanville Formation at Port Adelaide. Q. geol. Notes, geol. Surv. S. Aust., 57: 4-7.

Murray - Wallace, C.V., Kimber, R.W.L., Gostin, V.A. and Belperio, A.P., 1987. Amino acid racemisation dating of the "Older Pleistocene marine beds", Redcliff, Northern Spencer Gulf, South Australia. Trans. R. Soc. S. Aust.,

Preiss, W.V. and Forbes, B.G., 1981. Stratigraphy, correlation and sedimentary history of Adelaidean (Late Proterozoic) basins in Australia. Precamb. Res., 5:255-304.

Williams, G.E., 1969. Glacial age of piedmont alluvial deposits in the Adelaide area, South Australia. Aust. J. Sci., 32: p. 257.

APPENDIX 1

Core and Cutting descriptions

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
			Rotary Cuttings at 4·57m intervals
	0		Pale yellowish orange unconsolidated SKELETAL SAND with abundant gastropods, bivalve detritus, foraminifera and coralline algae.
			Moderate yellowish brown micaceous SANDY CLAY, skeletal debris (contaminant) and cemented SKELETAL LIMESTONE comprising foraminifera (incl *marginopora vertebralis*), mollusca and coralline algae.
			Yellowish brown and reddish brown; poorly sorted SANDY CLAY.
	10		Pale to yellowish orange, mixed SKELETAL and QUARTZ SANDSTONE. Well cemented and comprises foraminifera, mollusca and coralline algae
			Mottled, light brown and light grey, very poorly sorted, micaceous SANDY CLAY. Well rounded quartz grains.
			As above
	20	RS405	As above but including greyish-orange mottles and patches of soft carbonate silt.
			Mottled, reddish brown, yellow brown and light olive grey SANDY, SILTY CLAY. Stiff and blocky.
	30		As above
			Yellowish orange, very poorly sorted, coarse angular SAND.
			Mottled, reddish brown and yellow brown SANDY, SILTY CLAY.
			Yellowish orange, very poorly sorted, coarse angular SAND.
	40		Mottled reddish brown and light olive grey SANDY CLAY Gravelly lenses with quartz and dolomitic siltstone pebbles.
			As above but contaminated with surficial bioclastic debris due to driving of casing.

4474

MF 165

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
	50		Mottled and rubified, red brown SILTY CLAY. Stiff, occasional organic fibres.
		RS406	Mottled olive grey and bluish grey, stiff SILTY CLAY Gleyed soil profile from 54 to 60m.
	60		Mottled yellowish grey and light olive grey, fine grained SANDY CLAY. Micaceous and non-calcareous.
		RS407	Reddish brown and olive grey, non-calcareous SANDY CLAY and very pale orange, poorly sorted calcareous SANDSTONE. Micritic cement with well rounded quartz grains and a few pelecypod fragments.
	70	RS408	Greyish red and light olive grey, poorly sorted SANDY CLAY. Weakly calcareous with well rounded quartz grains.
			White and yellowish orange calcareous SANDSTONE. Well cemented with micrite, and containing well rounded quartz grains, heavy minerals, small foraminifera (incl *marginopora* & *elphidium*) and occasional pelecypod fragments.
			Pale yellowish brown MUDDY SHELLY SAND, with abundant bivalve and gastropod fragments, bryozoa and foraminifera. Some fragments of cemented calcareous sandstone.
	80	RS409	Very light grey, coarse SANDY SHELLY MUD with abundant mollusc detritus. Fragments of cemented calcareous SANDSTONE. Some mottled pale clay. Organic fragments.
		RS410	Pale to dark yellowish brown, very poorly sorted, sandy SHELLY MUD. Large well rounded quartz grains, disseminated glauconite and abundant molluscan detritus. Organic rich with fibrous (seagrass?) detritus up to 3cm in length. Minor pale brown MUDSTONE and platy grey SILTSTONE.
	90		Yellowish brown to light grey, sandy shelly marl and bryozoal calcarenite. Poorly sorted, weakly consolidated with fibrous organic remains. Some firmly cemented quartzose calcareous sandstone.
			As above but increasing mud content and increasing foraminiferal and bryozoal components.

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3 mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528		DESCRIPTION
	100			White to light grey, coarse grained, BRYOZOAL LIMESTONE. Very poorly sorted and weakly cemented, and with abundant echinoid and mollusca components, some glauconite. Fragments of red brown, non-calcareous SANDY MUDSTONE, and grey non calcareous SANDSTONE.
				White, coarse grained bryozoal and foraminiferal CALCARENITE. Minor pelletal glauconite and echinoid spines and plates. Some light grey, weakly calcareous SANDY MUDSTONE.
	110			As above
			RS411	White to light grey, coarse bryozoal and foraminiferal CALCARENITE, light grey MUDDY CALCARENITE, and mottled light grey to orange, non-calcareous SANDY MUDSTONE. In proportion 50:30:20
	120			No sample
				White, coarse, bryozoal, foraminiferal and glauconitic CALCARENITE. Light grey, very poorly sorted SANDY MARL with well rounded and often ferruginised quartz grains. Minor fragments of yellowish brown, non-calcareous SANDY MUDSTONE.
	130			Pale yellowish brown, quartzose CALCARENITE. Very poorly sorted mixture of very well rounded but rubified quartz grains, foraminiferal, echinoid and bryozoal detritus, and a soft clay matrix. Some fragments of red-brown, non-calcareous, MUDDY SANDSTONE.
				As above but including fragments of light grey CALCARENITE and minor white, SANDY CALCILUTITE. Occasional FERRICRETE fragments.
				As above but including minor woody fragments.
	140			Light grey, very poorly sorted CALCARENITE, with subordinate well rounded, rubified quartz, minor glauconite and some black-stained foraminifera. Skeletal component is predominantly composed of echinoid, foraminifera and bryozoa. Entirely marine.

4474

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE / UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
	150		Light grey muddy foraminiferal, echinoid and bryozoal CALCARENITE and poorly sorted, greenish grey (including grains and patches of green glauconite) skeletal - quartz SANDSTONE. Large echinoid plates and numerous black-stained foraminifera. Some coarse, well rounded quartz grit fragments. Most quartz grains are well rounded and stained with a ferruginous coating.
			As above but more abundant glauconite and more molluscan debris.
			MUDDY CALCARENITE, light olive grey, including grains of glauconite and glauconite replaced echinoid spicules. Some weakly calcareous, dark grey fine saccharoidal SANDSTONE (faecal origin) and red brown non-calcareous SANDY MUDSTONE
	160		As above, glauconite occurs as discrete pellets, as replacement of matrix, as replaced skeletal fragments, and as matrix infilling of lithoskels.
			Range of lithologies from light grey glauconitic, MUDDY CALCARENITE, light grey mixed skeletal and quartz SANDSTONE, dark grey, non-calcareous fine grained, quartz SANDSTONE, red brown non calcareous SANDY MUDSTONE, and medium-grey non-calcareous MUDSTONE.
	170	RS412	Poorly sorted medium grey, muddy and sandy foraminiferal, glauconitic bryozoal and echinoid CALCARENITE. Some larger molluscan debris. Alternating well cemented and poorly cemented horizons
			As above but including minor light grey SANDY MARL. Some large, well rounded, ferruginised quartz grains.
			As above
	180		Medium grey, very poorly sorted, very muddy CALCARENITE (foram, mollusc, echinoid, bryozoa and glauconite), alternating with silicified (cherty?) finer grained, medium grey, similarly poorly sorted CALCARENITE. Occasional large, ferruginised, well rounded quartz grains.
			As above
	190		As above but including a more prominent gastropod fauna.

Sheet 4 of 15
Plan No. S19607a

4474

MF 165

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
			Fine to medium grained, dark grey, very muddy, glauconitic CALCARENITE (foram, mollusc, echinoid and bryozoal components). Alternating soft, uncemented layers and silicified, finer grained and less calcareous layers.
	200	RS413	Dark grey, weakly cemented, weakly calcareous SANDY MUD. Poorly sorted with discrete rounded glauconite grains and pellets. Less common fragments of silicified CALCARENITE and MUDDY CALCARENITE.
			As above, predominantly dark grey and brownish grey MUDSTONE. Minor MUDDY CALCARENITE and coarser molluscan detritus.
	210		As above, dark grey, weakly calcareous, micaceous MUDSTONE, in places intensively burrowed with burrows infilled with uncemented fine skeletal and glauconitic sand. Minor fragments of well cemented, CALCARENITE, larger molluscan detritus, and large, well round, ferruginised quartz grains.
		RS414	Dark grey, non-calcareous micaceous MUDSTONE (70%) and fine to medium grained, well cemented glauconitic SKELETAL LIMESTONE (30%). Well rounded glauconite pellets and larger rubified quartz grains. Skeletals include bivalve gastropod, foraminiferal, echinoid, bryozoal and algal detritus.
	220		As above, including framboidal pyrite and remnant organic sheaths (? seagrass fibre) in limestone.
			Predominantly black, non calcareous, micaceous and pyritic MUDSTONE with abundant disseminated pyrite and finely dispersed organics. Subordinate grey, weakly calcareous, micaceous MUDSTONE, burrowed and bioturbated with muddy skeletal sand. Minor light grey, weakly cemented, muddy glauconitic, SKELETAL LIMESTONE.
	230		Predominantly burrowed, micaceous MUDSTONE (40%) and muddy glauconitic SKELETAL LIMESTONE (40%) Subordinate black non-calcareous, micaceous and pyritic MUDSTONE (20%)
		RS415	Predominantly well cemented light grey, muddy, glauconitic SKELETAL LIMESTONE. Subordinate weakly calcareous, grey, micaceous MUDSTONE. Minor black non-calcareous, micaceous and pyritic MUDSTONE.
	240		As above

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
			As above
	250	RS416	Predominantly glauconitic, muddy SKELETAL LIMESTONE, alternately well cemented and poorly cemented. Also fragments of silicified glauconitic SANDSTONE.
			Abundant dark grey, well cemented, poorly sorted, fine to medium grained, silicified glauconitic SANDSTONE. Weakly calcareous and with well rounded glauconitic pellets and saccharoidal, well rounded but poorly sorted quartz grains. Subordinate grey, muddy glauconitic SKELETAL LIMESTONE. Minor brownish-black, non-calcareous, micaceous and pyritic MUDSTONE. Minor grey, weakly calcareous, burrowed micaceous MUDSTONE. Abundant faecal sandstone pellets to 1cm diameter, containing very well rounded and well sorted quartz grains.
	260		Predominantly dark grey, weakly cemented, glauconitic SANDY MUD. Very poorly sorted but very well rounded vitreous quartz grains. Well rounded glauconite pellets, weakly calcareous and abundant fine dispersed organic matter. Minor weakly cemented, muddy glauconitic SKELETAL LIMESTONE. Minor pyritic and micaceous burrowed MUDSTONE.
			As above
	270		Predominantly black, non-calcareous, weakly cemented, very poorly sorted, (? non-marine) SANDY MUD. Contains well rounded quartz, finely disseminated organics and minor glauconite pellets. Minor light grey, glauconitic, muddy SKELETAL LIMESTONE.
		RS417	Predominantly olive-black, unconsolidated, very poorly sorted, glauconitic fine SAND. Foraminiferal silty matrix with abundant framboidal and disseminated pyrite and organics. Quartz grains are vitreous, and both quartz and glauconite grains are well rounded. Minor bryozoa and echinoid fragments and pyritised, infilled burrows. Minor fragments of muddy, glauconitic SKELETAL LIMESTONE, minor fragments of black, micaceous and pyritic MUDSTONE, and minor fragments of a dark grey, fine saccharoidal SANDSTONE. Principal skeletals comprise entire and comminuted bivalves and gastropods, foraminifera, and minor brozoan and echinoid fragments.
	280		As above but increasing mud and organic content and decreasing content of skeletal detritus and foraminiferal microfauna. Other fragments of light grey, bimodal fine SANDSTONE with a population of well rounded, coarse quartz grains and glauconite pellets and a sparse foram microfauna. Abundant pyritised organic fragments, and pyrite framboids to 3mm diameter.

4474

MF 165

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 6528 1600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3m AHD (approx.)

AGE / UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
	290	RS418	As above Predominantly non-calcareous, black fine grained, micaceous and pyritic fine sandy LIGNITIC MUDSTONE with leaf impressions. Abundant pyrite framboids, minor glauconite pellets. Also brownish black, very poorly sorted, unconsolidated, calcareous, micaceous and organic SANDY MUD, containing a sparse foraminiferal fauna, and pockets of skeletal-rich sand.
			As above, minor ferruginised grains and red-brown clay.
	300	RS419	Black, pyritic, glauconitic and LIGNITIC SANDY MUD (40%). Also sparsely biogenic, brown micaceous SANDY MUD (40%). Fragments of bimodal, dark grey, glauconitic SILTY SAND (10%) and minor light grey SHELLY MARL (10%)
			Predominantly dark brown, grading to light grey and white, mottled, non-calcareous, very poorly sorted SANDY MUD (60%). Some light grey, calcareous, glauconitic, SANDY MUDSTONE (15%) Fragments of brownish-black, pyritic, micaceous and glauconitic, non-calcareous SANDY MUDSTONE (10%). Minor black, pyritic LIGNITIC MUDSTONE (5%), dark grey, bimodal, glauconitic MUDDY SANDSTONE (5%) and grey-green, glauconitic CALCARENITE (5%).
	310	313·3 CORE CUT 315·3 Rotary - no samples	White to light grey, non-calcareous, fine grained QUARTZ SANDSTONE. Grains moderately rounded, well sorted and well packed with good grain to grain contact and a silica cement. Minor feldspar, heavy minerals and opaque grains. Cross-bedded and graded, from coarse GRITTY SANDSTONE up to fine QUARTZITE. Small mud lump impressions and ? cavities after ? pyrite. Dip approx. 25°, facing up. Interbeds to 3cm thick of pale plastic mud may be Cainozoic infilling of surficial joints and fractures.
	320	318·6 RS420 CORE	322m, Strata Dip 35°→W, facing up. Joints Dip 75°→E, infilled with chlorite and pyrite. White to light grey, non-calcareous fine to medium grained quartz sandstone Moderately sorted and minor ripple drift crossbedding, some co-sets 30cm thick. Decimetre thick interbeds of weathered, poorly sorted, muddy sandstone. Millimetre thick mud-drapes accentuate bedding. Rare thicker mud layers to 1cm and mud lumps. Pyrite associated with mud drapes and as disseminated spherules. [Interpretation - shallow, sandy tidal basin] Possible fracture zone (slickenside) associated with core loss at 330-330·8m
	330		Lateral accretion surfaces (30° corrected) at 333·4m, possible predominant/subordinant current effect. Underlain by mud drapes with sulphide.

Sheet 7 of 15
Plan No. S19607g

4474

MF 165

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 6528 1600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3m AHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG	DESCRIPTION
	340		Gritty, coarse and well rounded at 338·2m. Interlaminated grey, micaceous mudstone and ripple-drift cross-bedded, poorly sorted sand from 338·6 - 339·6. Centimetre scale bedding and abundant water escape structures.
			Quartzite as above, with abundant pyrite spheriods along bedding planes and foreset beds.
			Quartzite as above, but silty and less indurated
			Quartzite as above.
	350		? Burrow down axis of core at 348·6m. 1cm radius of coarse, well rounded quartz grains in fine grained, trough cross bedded quartzite. Fining upward co-sets to 40cm with lateral accretion surfaces, mud drapes and reactivation surface. ? Burrow at 351·75m, 1cm radius, coarse well rounded quartz grains. 352·5 - 354·9m. Interlaminated, grey, fine sandstone and grey-black sandy mudstone. Mudcrack at 353·7m, flaser bedded, water escape structure
			354·9 - 357·9m. Quartzite with mud drapes and pyrite spheriods.
			357·9 - 358·7m. Grey-black silty mudstone with interbeds of coarse quartz sand and starved ripples.
	360		358·7 - 360·4m. Dense, grey quartzite with pyrite spheriods and rare mud drapes.
			360·4 - 362·5m. Grey-black silty mudstone with interbeds to 2cm of sandstone, starved ripples.
			362·5 - 370·3m. Grey, fine grained, dense quartzite, fine to medium grained, well rounded. Mud drapes, mud clasts and thin mud interbeds. Crossbed co-sets to 30cm (migrating megaripple field). Several decimetre thick, plane bedded, coarsening up beds.
	370		370·3 - 370·5m. Mottled red-brown and orange, calcareous interclastic sandstone. Poorly sorted with large very well rounded grains (aeolian). Result of exposure - ? palaeosol imprint on sandstone.
			370·5 - 402·1m. Predominantly, grey-white, dense, fine to medium grained quartzite. Mud drapes, mud clasts and synsedimentary pyrite spheroids up to 1mm in diameter. Intervals of up to 3m of inter-bedded, flaserbedded mudstone and sandstone. Sand-mud couplets are small scale fining upwards laminae.
	380		
			Dip 35°

Sheet 8 of 15
Plan N° S19607h

4474

MF 165

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 6528 1600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3m AHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
	390	RS421	? Mudcracks infilled with sand at 385·85m, repetative sand-mud fining upwards cycles. Finely disseminated pyrite.
		OXM	Lateral accretion surfaces with reactivation. 30° →W. (corrected)
			396·8m, lateral accretion surfaces; bidirectional reactivation 30°→W (corrected) subordinate reactivation →east
	400	RS422 OXM	Minor secondary dolomite in fractures
		RS423	402·1 - 422·0m. Predominantly interbedded and interlaminated grey-green mudstone (occasionally oxidised to red-brown), poorly sorted, chloritic and feldspathic medium grained sandstone and white-grey, dense, fine to medium grained quartzite. Abundant mud drapes, mud lumps, and lateral accretion crossbedding.
		OXM RS424	Grey-green and red-brown micaceous mudstone, fining upward laminae and starved ripples. Pyrite outlined burrow down core axis. Dip 40°
	410	RS425 OXM	Pyrite spheroids to 1·5mm diameter.
		OXM	Mud lumps rarely replaced by calcite.
		OXM OXM	
	420	RS426	422·2 - 458·4m. Predominantly white to light grey, dense quartzite. Remnant, well rounded, medium quartz grains. Thin mud drapes and mud laminae mud lumps. Granular and less silicified where more poorly sorted. Rare, oxidised, red micaceous mudstone interbeds to 10cm thick. Decimetre scale cosets showing lateral accretion surfaces. Zones of soft sediment deformation and convoluted bedding (sandstone dykes) and locally abundant pyrite spheroids.
		OXM	
	430		

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
	440	OXM	Convolute bedding (? soft sediment deformation), partly fractured
	450	OXM	Post-depositional brecciation, quartzite and mudstone.
	460	OXM OXM	458.4 - 503.9m. Interbedded and interlaminated, grey, medium grained poorly sorted, feldspathic sandstone and grey-green micaceous mudstone. Mudstone beds locally oxidised to red-brown. Abundant mud pellets, mud lumps in sandstones. Some trough crossbedding but mostly unidirectional foreset bedding. Individual mudstone beds with starved ripples are up to 50cm thick, but are also form centimetre and millimetre scale rythmic sand-mud couplets. Abundant water escape structures and synerisis cracks. Synsedimentary pyrite associated with fine mud flasers and spheriodal pyrite with sandstones (pyritised mud pellets or faecal pellets) secondary sulphides with vertical joint fractures (strike 200° at 466.4m)
	470	OXM RS427	
	480		

Sheet 10 of 15
Plan N° S19607j

4474

MF 165

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 6528 1600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3m AHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
	490	OXM	
		RS428	
		OXM	Exposure surface with rip-upclasts and lag deposists
	500	OXM	
		RS429	503·9 - 506·7m. Grey-green, fine, sandy micaceous mudstone. Thin laminae and starved ripples of medium grained, poorly sorted, feldspathic sand. Finely dissemanted sulphide. Dip 30°
		OXM	506·7 - 558·5m. Grey, poorly sorted, medium grained, feldspathic bimodal muddy sandstone. Well rounded quartz grains. Secondary chlorite and amphibole. Abundant thin mudstone laminae, mud drapes and mud lumps. Trough crossbedding. Occasional thicker mudstone bed to 60cm thick.
	510	OXM	
		OXM.	
		RS430	
		OXM	mudcrack
	520		NQ core

Sheet 11 of 15
Plan N° S19607k

4474

MF 155

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
	530		
	540	OXM	Post-depositional, dolomite-host bracciation of quartzite and lower shale.
	550	OXM	
		RS431	2cm thick cream, calcilutite bed with large well rounded quartz grains trough crossbedded.
		OXM	558.5-588.0m. Interbedded quartzite, muddy sandstone and mudstone. Quartzite is grey, fine grained and dense. Coarser sandstone beds are poorly sorted, muddy and feldspathic with abundant mud drapes, mud laminae and mud lumps. Mudstone beds are grey-black or variably oxidised to red-brown, micaceous and chloritic, and contain starved ripples, thin sand beds and water escape structures and synerisis cracks. Quartzites are coarse and poorly sorted immediately above sharp contacts, with mudstones, and finer upward rapidly. They contain abundant mud drapes.
	560	OXM	
		RS432	
		OXM	
		OXM	
		OXM	
	570	OXM	

Sheet 12 of 15
Plan N° S19607 1

4474

MF 165

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG 6528	DESCRIPTION
	580	OXM OXM	Sequence of stacked, poorly sorted quartzites with foreset bedding, shale clasts and possible double mud drapes.
	590	OXM OXM OXS	588.0 - 682.0m (E.O.H.). Interbedded, grey-black, sandy, muddy siltstone, silty mudstone, and poorly sorted, gritty and pelletal sandstone with abundant thin siltstone laminae. Dewatering structures mud drapes and mud clasts are less common, through, medium grained rounded mud pellets (faecal origin?) now chloritised to green and green black grains, are abundant. Oxidised mudstone beds and oxidised gritty sandstone beds are common. Red colouration has resulted from prefirrential ferruginization of matrix along coarser laminae (Haematite). Millimetre to centimetre scale rhythmic alternation of siltstone and sandstone laminae.
	600	OX	
	610	OXM OXM OXS P OXS OXS	
		P RS433 P, OXS P OXM OXM P, OXM OXS	
	620	OXM OX OX RS434 RS435 OXM P OXS	Weakly calcareous, haematitic, poorly sorted sandstone. Calcite filled joints, conjugate sets at 45° to core axis. Strata Dip 30°. ? double mud drapes and reactivation surfaces chert / dolomite rosettes, 10mm diameter (? after anhydrite)

Sheet 13 of 15
Plan N° S19607m

4474

MF 165

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 6528 1600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A. B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG	DESCRIPTION
		6528	
	630		
	640		(? green grains in sandstone)
	650		Black pellets
	660		
	670		Mud laminae doublets ?

Sheet 14 of 15
Plan N° S19607a

4474

MF 163

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

PORT GAWLER 3

CORE AND CUTTINGS DESCRIPTION

REF: 65281600W01100 INCLINATION: 90°
LAT: 34°39'14"S LONG: 138°26'43"E DEPTH: 682m
LOGGED BY: A.B. DATE: 1-3-87 DRN: R.B.
DRILLED: 13-7-86 – 25-2-87 ELEV: 3mAHD (approx.)

AGE/UNIT	DEPTH (m)	GRAPHIC LOG	DESCRIPTION
		6528 OX OX P P RS438 OX	
	680	OX	
			E.O.H 681.97m (core depth)

grit, gritty
quartzite, sandstone
siltstone, silty
mudstone, muddy
graded bedding
convolute bedding
flaser bedding
starved ripples
mud drapes
lateral accretion cosets
crossbedding
trough crossbedding
mud lumps
p pellets
pyrite
burrow
mudcrack
water escape structure
breccia zone
ox oxidised (mud, sand)
6528RS405 sample taken

Sheet 15 of 15
Plan No. S196070

4474

MF 165

APPENDIX 2

Results of phosphate, carbon and carbonate analyses for 15 Cainozoic samples.
AMDEL Report AC 3253/87

amdel

Method: MIS3/2, ORE 2/5 Report AC3253/87

Results in Percent

Sample ID	Total Carbon	CO2
6528 RS 405	0.78	2.72
6528 RS 406	0.04	0.14
6528 RS 407	4.88	17.3
6528 RS 408	0.12	0.34
6528 RS 409	3.20	10.8
6528 RS 410	5.10	18.2
6528 RS 411	8.75	31.7
6528 RS 412	5.40	17.5
6528 RS 413	3.62	8.3
6528 RS 414	3.76	9.15
6528 RS 415	4.64	14.0
6528 RS 416	5.45	17.3
6528 RS 417	2.12	3.32
6528 RS 418	11.8	3.14
6528 RS 419	13.0	2.88

amdel

Analysis code URE6/1/2 Report AC 3253/87 Page I1

NATA Certificate Results in %

Sample	P2O5
6528RS405	0.060
6528RS406	0.050
6528RS407	0.030
6528RS408	0.040
6528RS409	0.030
6528RS410	0.040
6528RS411	0.030
6528RS412	0.040
6528RS413	0.050
6528RS414	0.130
6528RS415	0.050
6528RS416	0.060
6528RS417	0.070
6528RS418	0.030
6528RS419	0.050
Detn limit	(0.010)

APPENDIX 3

Semiquantitative mineralogy for
15 Cainozoic samples

Principal mineral peak heights, normalised from XRD chart peaks using Cokα radiation at 1° per min. scan speed.

Mineral Peaks

Sample	1	2	3	4	5	6	7	8	9	10	11
6528 RS 405	78	.	.	3	7	5	.	.	7	.	.
406	83	.	.	8	5	4	.	.	.	.	.
407	49	.	4	3	3	.	.	.	42	.	.
408	72	.	.	6	9	5	.	.	8	.	.
409	83	.	.	3	3	3	.	.	8	.	.
410	68	.	.	.	3	1	.	.	.	11	9
411	29	.	.	.	1	1	.	.	47	21	.
412	36	8	.	.	1	.	1	.	42	8	4
413	63	.	.	.	1	.	1	16	14	8	5
414	58	.	5	.	5	.	3	13	14	3	.
415	21	15	8	.	.	.	.	21	27	.	8
416	27	8	.	.	1	.	1	13	5	45	.
417	85	.	6	.	1	.	.	6	3	.	.
418	66	.	12	.	3	2	.	6	3	7	.
419	86	.	.	.	2	2	.	3	4	3	.

1. Quartz
2. Opal A + Opal CT
3. Orthoclase
4. Plagioclase
5. Muscovite/Illite
6. Kaolinite
7. Montmorillonite
8. Clinoptilolite
9. Calcite/Low Magnesian Calcite
10. Dolomite
11. Aragonite

APPENDIX 4

Geochemical results for 20 Proterozoic samples
AMDEL Report AC 3254/87

amdel

Method: MIS3/2, MIS2 Report AC3254/87

Results in Percent

Sample ID	Total Carbon	Sulphur
6528 RS 420	0.02	1.61
6528 RS 421	0.11	0.51
6528 RS 422	0.05	0.12
6528 RS 423	0.04	0.46
6528 RS 424	0.06	0.40
6528 RS 425	0.16	1.87
6528 RS 426	0.05	1.73
6528 RS 427	0.04	0.28
6528 RS 428	0.25	3.20
6528 RS 429	0.02	0.96
6528 RS 430	<0.02	<0.1
6528 RS 431	2.70	0.12
6528 RS 432	4.55	0.37
6528 RS 433	0.06	0.26
6528 RS 434	0.71	<0.1
6528 RS 435	0.03	<0.1
6528 RS 436	0.44	0.24
6528 RS 437	0.04	0.14
6528 RS 438	0.25	<0.1
6528 RS 439	0.07	0.26

amdel

Analysis code PM1/2 Report AC 3254/87 Page G1

NATA Certificate Results in ppm

Sample	Au
6528 RS 420	<0.02
6528 RS 421	<0.02
6528 RS 422	<0.02
6528 RS 423	<0.02
6528 RS 424	<0.02
6528 RS 425	<0.02
6528 RS 426	<0.02
6528 RS 427	<0.02
6528 RS 428	<0.02
6528 RS 429	<0.02
6528 RS 430	<0.02
6528 RS 431	<0.02
6528 RS 432	<0.02
6528 RS 433	<0.02
6528 RS 434	<0.02
6528 RS 435	<0.02
6528 RS 436	<0.02
6528 RS 437	<0.02
6528 RS 438	<0.02
6528 RS 439	<0.02
Detn limit	(0.02)

amdel

Analysis code ORE2/1+2/2 Report AC 3254/87

NATA Certificate Results in percentages

	6528RS 420	6528RS 421	6528RS 422	6528RS 423	6528RS 424
SiO2	94.2	77.8	48.6	78.9	56.2
TiO2	0.04	0.68	1.45	0.77	1.25
Al2O3	0.41	8.45	21.9	8.20	17.8
Fe2O3	2.02	3.32	9.45	3.64	8.40
MnO	<0.010	0.03	0.03	0.01	0.03
MgO	0.01	1.33	3.26	1.35	3.36
CaO	0.03	0.47	0.44	0.24	0.40
Na2O	<0.010	0.98	0.79	0.81	1.17
K2O	0.12	2.88	6.75	2.48	4.70
P2O5	<0.010	0.14	0.19	0.10	0.15
LOI	1.37	2.20	5.70	1.97	4.82
Totals	98.2	98.3	98.6	98.5	98.3
BA	<0.002	0.037	0.049	0.032	0.048
CU	0.036	0.018	0.005	0.010	0.012
ZN	<0.001	0.010	0.007	0.002	0.007
ZR	0.004	0.028	0.033	0.029	0.025

Total FE as Fe2O3

amdel

NATA Certificate Results in percentages

	6528RS 425	6528RS 426	6528RS 427	6528RS 428	6528RS 429
SiO2	82.7	83.9	60.4	61.2	58.7
TiO2	0.40	0.38	1.16	1.09	1.15
Al2O3	4.68	4.68	16.2	13.6	16.9
Fe2O3	3.70	3.72	7.30	8.55	7.15
MnO	0.03	0.01	0.02	0.06	0.02
MgO	0.74	0.74	2.72	2.32	2.80
CaO	0.94	0.22	0.36	1.05	0.33
Na2O	0.49	0.49	1.37	1.25	1.22
K2O	1.75	1.58	4.64	3.92	5.05
P2O5	0.22	0.08	0.16	0.29	0.16
LOI	2.62	2.20	3.96	5.40	4.74
Totals	98.3	98.0	98.3	98.7	98.2
BA	0.024	0.020	0.048	0.038	0.071
CU	0.009	<0.001	0.004	0.007	0.004
ZN	0.003	<0.001	0.003	0.004	0.004
ZR	0.020	0.011	0.022	0.024	0.021

Total FE as Fe2O3

amdel

Analysis code ORE2/1+2/2 Report AC 3254/87

NATA Certificate Results in percentages

	6528RS 430	6528RS 431	6528RS 432	6528RS 433	6528RS 434
SiO2	59.3	71.1	30.5	68.9	77.2
TiO2	1.38	0.34	0.86	1.21	0.08
Al2O3	17.3	2.56	12.0	11.4	1.54
Fe2O3	6.75	1.70	11.9	7.50	12.6
MnO	0.02	0.38	0.85	0.03	0.20
MgO	2.48	3.94	8.40	2.16	1.20
CaO	0.44	6.45	11.0	0.37	1.75
Na2O	1.61	0.34	0.44	0.82	<0.010
K2O	5.05	1.23	3.64	2.84	0.35
P2O5	0.20	0.04	0.20	0.19	0.12
LOI	3.78	10.1	18.4	2.78	3.06
Totals	98.3	98.2	98.2	98.2	98.1
BA	0.047	0.017	0.027	0.038	0.011
CU	0.004	0.002	0.153	0.005	0.004
ZN	0.004	<0.001	0.004	0.004	<0.001
ZR	0.026	0.015	0.014	0.024	0.004

Total FE as Fe2O3

amdel

NATA Certificate Results in percentages

	6528RS 435	6528RS 436	6528RS 437	6528RS 438	6528RS 439
SiO2	79.3	89.0	75.9	80.3	58.8
TiO2	0.93	0.26	0.74	0.67	1.05
Al2O3	6.40	2.14	8.25	6.45	16.6
Fe2O3	5.70	1.34	5.65	3.48	8.40
MnO	0.01	0.12	0.02	0.07	0.03
MgO	1.19	0.69	1.97	0.53	2.96
CaO	0.27	1.38	0.28	0.86	0.40
Na2O	0.74	0.25	0.78	1.76	1.31
K2O	1.94	1.06	2.02	2.50	4.40
P2O5	0.16	0.06	0.14	0.17	0.19
LOI	1.51	2.20	2.36	1.39	4.10
Totals	98.2	98.5	98.1	98.2	98.2
BA	0.039	0.018	0.024	0.042	0.048
CU	0.025	0.003	0.010	0.007	0.010
ZN	0.002	<0.001	0.003	0.002	0.007
ZR	0.018	0.007	0.016	0.013	0.021

Total FE as Fe2O3

APPENDIX 5

Petrographic descriptions for 20 Proterozoic samples

AMDEL Report G 7017/87

amdel
technology and enterprise

Amdel
31 Flemington Street,
Frewville, S.A. 5063

Telephone: (08) 372 2700

Address all correspondence to:
P.O. Box 114,
Eastwood, S.A. 5063

Telex: AA82520
Facsimile: (08) 79 6623

27 March 1987

GS 1/13/0

South Australian Department of
Mines & Energy,
P.O. Box 151,
EASTWOOD, S.A. 5063

ATT: A.P. BELPERIO - REGIONAL GEOLOGY

REPORT G 7017/87

YOUR REFERENCE:	12/07/0017 EX-630
IDENTIFICATION:	6528 RS420-439
MATERIAL:	Quarter core samples
LOCALITY:	Pt. Gawler No. 3 Drillhole
DATE RECEIVED:	23 March 1987
WORK REQUIRED:	Petrography (20 Code MA1.3)

Investigation and Report by: Frank Radke

Manager - Geological Services: Dr Keith J Henley

for Dr William G Spencer
General Manager
Applied Sciences Group

bp

amdel

PETROGRAPHY OF TWENTY SEDIMENTARY ROCKS

1. SUMMARY

Twenty samples from the Pt. Gawler No. 3 Drillhole submitted by the South Australian Department of Mines and Energy for petrographic examination were given the following rock names.

SAMPLE & THIN SECTION NO.	DEPTH (m)	ROCK NAME
6528 RS420: TS46124	322	Quarzite
6528 RS421: TS46125	386	Argillaceous sandstone
6528 RS422: TS46126	400.6	Shale
6528 RS423: TS46127	403.5	Quartzite with shale bands
6528 RS424: TS46128	409.0	Shale
6528 RS425: TS46129	411.4	Quartzite/shale
6528 RS426: TS46130	423.0	Quartzite
6528 RS427: TS46131	466.42	Siltstone
6528 RS428: TS46132	492.95	Siltstone with sandstone bands
6528 RS429: TS46133	504.25	Siltstone with sandstone lamellae
6528 RS430: TS46134	516.4	Siltstone with shale lamellae
6528 RS431: TS46135	553.16	Sandstone with (?)dolomite lamellae
6528 RS432: TS46136	563.15	Sandstone/(?)dolomite
6528 RS433: TS46137	614.1	Sandstone with siltstone bands
6528 RS434: TS46138	620.35	Sandstone
6528 RS435: TS46139	621.55	Fine grained sandstone
6528 RS436: TS46140	643.7	Sandstone
6528 RS437: TS46141	655.1	Sandstone
6528 RS438: TS46142	678.75	Fine grained sandstone
6528 RS439: TS46143	655.9	Silty shale

Samples 6528 RS420 to RS434 are described as coming from the ABC Range Quartzite and samples 6528 RS433 to RS439 were described as being from the Brachina Formation.

All of these samples are detrital sedimentary rocks ranging from sandstones to shales. Most of the samples show relatively fine banding with variations in grain size between bands and many samples consist of alternating sandstone and shale or siltstone bands. A small number of samples (6528 RS431 and RS432) also contain dolomite bands.

The samples described as coming from the Brachina Formation generally contain green pellets which have been termed chlorite. These pellets are typically lacking from the samples described as being from the ABC Range Quartzite. In some samples these pellets have been partially replaced by quartz or carbonate and sample 6528 RS438 is thought to contain completely silicified pellets.

2. PETROGRAPHY

All of the thin sections described in this report have been stained with an alizarin red-S solution to distinguish calcite from other carbonates by staining it pink. In the petrographic descriptions calcite is used only for stained carbonate. Most of the carbonate in these samples is unaffected by the alizarin red-S stain and is thought to be dolomite.

SAMPLE: 6528 RS420: TS46124

Rock Name:
Quartzite

Hand Specimen:
A pale grey to tan coloured rock with a well indurated, finely granular texture. A vague banding with a possible coarse bedded character is present in this sample. This interval also contains some narrow bands up to 1 mm wide with a darker grey to black colour.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	90
Clay	5
Sericite	Tr-1
Tourmaline	Tr
Carbonate	Tr
Opaques	1
Pores	3

This sample consists mainly of recrystallised, detrital quartz grains with a typical size ranging between 0.1 and 0.3 mm. The quartz grains form an interlocking mosaic produced by a recrystallised character as well as the development of overgrowth quartz. Many detrital quartz grains exhibit rounded textures produced by faint growths separating the detrital quartz grain from the overgrowth. Included with the detrital quartz are a very small number of finely granular, cherty-textured detrital quartz grains.

A pale tan, weakly birefringent clay occurs interstitially between the quartz grains locally filling angular spaces up to 0.15 mm wide. Very minor amounts of birefringent sericite are intergrown with this interstitial clay. Traces of muscovite were also noted as small inclusions within quartz grains. Traces of carbonate also occur as very small inclusions within some quartz grains.

Rounded detrital tourmaline grains ranging up to 0.3 mm in size are present. The tourmaline typically has a pleochroic green or pleochroic orange to brown colour.

Opaques are concentrated in bands approximately 1 mm wide where they occur interstitially between the quartz grains. This would represent the dark coloured bands noted in hand specimen. In addition to interstitial opaques some opaques fill narrow fractures within quartz grains. Minor opaques are also disseminated through the rock as small grains up to 0.2 mm wide.

The rock contains some void spaces up to 0.3 mm in size. Some of the voids as well as some irregular patches in the thin section have been anomalously stained with the alizarin red-S solution.

This is a quartz-rich detrital sediment comprised of recrystallised sand-sized quartz grains.

SAMPLE: 6528 RS421: TS46125

Rock Name:
Argillaceous Sandstone

Hand Specimen:
A banded rock on a scale ranging up to several millimetres wide comprised of alternating darker grey, finer-grained bands and slightly paler grey coarser grained bands.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	55
Argillaceous matrix	40
Feldspar	3
Carbonate	Tr
Tourmaline	Tr
Biotite	Tr
Zircon	Tr
Opaques	2

This sample consists mainly of detrital quartz grains disseminated through an argillaceous matrix. The banding which was noted in hand specimen is due mainly to variations in the proportion of sand-sized detrital quartz and argillaceous material in different bands. The coarser grained bands consist mainly of detrital quartz grains between 0.15 and 0.3 mm wide with minor interstitial argillaceous material. The finer-grained, darker coloured bands consist mainly of argillaceous material containing localised concentrations of fine sand to silt-sized detrital grains. These argillaceous bands in turn have a banded character with most of the finer-grained detritus being concentrated in narrower bands.

The larger quartz grains generally have rounded to subrounded shapes although a small number of quartz grains with subangular to angular shapes are also present. In addition to the detrital quartz minor detrital feldspar including polysynthetically twinned plagioclase and grid-iron twinned microcline is also present. Traces of tourmaline and zircon also form small detrital grains ranging up to 0.2 and 0.1 mm in size respectively. The detrital tourmaline grains in particular tend to have well-rounded shapes.

The argillaceous matrix consists mainly of weakly birefringent clay intergrown with a fibrous, slightly more birefringent phyllosilicate and some moderately well-developed muscovite/sericite flakes. The fibrous phyllosilicate as well as the muscovite/sericite flakes tend to exhibit a preferred orientation which is at an angle to the bedding. Some of the weakly birefringent clay has a very pale green colour and could be chloritic. This chloritic appearing clay is particularly well-developed as interstitial fillings between sand-sized detrital quartz grains in the coarser grained bands.

Minor carbonate was noted as small grains and granular aggregates up to 0.1 mm wide which are generally located interstitially between detrital quartz grains. Opaques are also disseminated through the rock as anhedral grains and aggregates ranging up to 0.2 mm wide. Within localised areas finely divided opaques tend to be concentrated in elongate, lenticular bands oriented parallel to the general banding. Most of the opaques tend to be intergrown with the argillaceous matrix.

Traces of biotite and muscovite occur as very small flakes below 0.05 mm in size which are totally included within quartz grains. The biotite typically has a pleochroic brown colour.

This is a banded detrital sedimentary rock containing some detrital quartz-rich bands separated by argillaceous bands with a minor silt to fine sand-sized detrital quartz component.

SAMPLE: 6528 RS422: TS46126

Rock Name:
Shale

Hand Specimen:
This is a fissile rock which generally has a dark reddish-brown colour although some bands and elongate lenticular bodies have a pale greenish-grey colour.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Clay matrix	70
Quartz	15
Sericite/muscovite	10
Feldspar	2
(?)Chlorite	1
Tourmaline	Tr
Zircon	Tr
Opaques	2

This sample consists mainly of weakly birefringent clay which forms a matrix through which detrital quartz grains are disseminated. In most of the sample the clay has a translucent, reddish-brown iron stained character but some bands and lenticular bodies consist of unstained clay. In most cases the bands in which the clay is unstained have a higher proportion of detrital quartz grains. These unstained detrital-rich areas tend to form elongate lenticular bodies and bands with a parallel orientation.

The matrix clay consists mainly of a very weakly birefringent material although some fibrous, slightly more birefringent clay is also present. Small muscovite/sericite flakes are also disseminated through the rock and tend to exhibit a preferred orientation parallel to the banding. Small flakes of a pleochoric green mineral with low birefringence believed to be chlorite are also locally present.

The detrital grains are generally below 0.05 mm in size although some larger detrital grains ranging up to 0.3 mm wide are locally present within narrow bands and lenses. Most of the detrital grains have subangular shapes. The detrital grains consist mainly of quartz along with a much smaller proportion of feldspar including grid-iron twinned microcline and polysynthetically twinned plagioclase. Traces of tourmaline and zircon also form detrital grains ranging up to 0.2 mm wide.

Minor opaques are disseminated through the rock as small grains and interstitial fillings. Opaques in particular tend to be concentrated in narrow discontinuous bands within the iron-stained portion of the rock. Some disseminated opaques have euhedral shapes typical of disseminated pyrite crystals.

This is an argillaceous detrital sediment comprised mainly of clay minerals with a small, fine sand to silt-sized quartz-rich detrital component.

SAMPLE: 6528 RS423: TS46127

Rock Name:
Quartzite with Shale Bands

Hand Specimen:
This is a very fine-grained, well indurated rock with a pale grey colour. The rock also exhibits some finer-grained darker grey bands many of which have an irregular character.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	65
Argillaceous matrix	30
Feldspar	2
Tourmaline	Tr
Carbonate	Tr
Zircon	Tr
Biotite	Tr
Opaques	2

This is a banded rock comprised mainly of a detrital quartz-rich band in contact with some argillaceous bands as well as some finer-grained quartz-rich bands. The argillaceous bands range up to a few millimetres in width and would represent the darker coloured bands noted in hand specimen. Many of these bands have highly irregular and contorted characters.

The widest band consists of detrital quartz grains between 0.2 and 0.4 mm in size which form an interlocking mosaic. Some overgrowth quartz is present but much of the quartz appears to have a recrystallised character. Some quartz grains with overgrowth quartz exhibit rounded cores. Minor feldspar including polysynthetically twinned plagioclase is intergrown with this quartz-rich band. Other quartz-rich bands tend to have a finer grain size which rarely exceed 0.1 mm although some larger grains ranging up to 0.3 mm in size are present. These finer-grained quartz-rich bands tend to have a slightly higher proportion of intergrown feldspar including both polysynthetically twinned plagioclase and grid-iron twinned microcline. Some bands comprised mainly of fine sand to silt-sized quartz intergrown with argillaceous material are also present.

Most of the argillaceous material in this rock is concentrated in bands up to a few millimetres wide comprised of weakly birefringent clay intergrown with a fibrous, slightly more birefringent material. Small amounts of birefringent muscovite/sericite are also disseminated through the shale bands as small flakes up to 0.1 mm wide. Minor amounts of detrital silt-sized quartz are also disseminated through the shale bands.

Similar argillaceous material occurs interstitial to the quartz in the finer-grained quartz bands. The coarser grained quartz band contains an interstitial pale green phyllosilicate with low birefringence which could be a chloritic phyllosilicate. Very minor birefringent sericite is locally intergrown with this chlorite. Small amounts of carbonate were also noted locally as interstitial fillings between the coarser grained quartz. This carbonate is unaffected by the alizarin red-S stain and locally forms vague rhomb-shaped crystals. Traces of biotite and muscovite form small flakes below 0.05 mm in size which are totally included within some larger quartz grains.

Opaques are disseminated through the rock as anhedral grains and aggregates up to 0.1 mm wide which tend to be concentrated in the argillaceous bands. Within the quartz-rich bands the opaques are associated with the interstitial argillaceous matrix. The contact between the coarser grained quartz band and a shale band exhibits a concentration of finely divided opaques.

This is a banded detrital rock comprised mainly of sand-sized detrital quartz grains separated by shaly, argillaceous bands up to a few millimetres wide.

SAMPLE: 6528 RS424: TS46128

Rock Name:
Shale

Hand Specimen:
A very fine-grained, medium to dark grey rock with a vague fissile foliation.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Argillaceous matrix	80
Quartz	15
Chlorite	1
Opaques	4

This sample consists mainly of an argillaceous matrix through which very fine sand to silt-sized quartz-rich detritus is disseminated. A fine lamellar banding on a scale ranging up to 0.5 mm in width is defined by slight variations in the proportions of detrital quartz within some bands as well as narrow variations in the degree of translucent brown staining of the argillaceous matrix. The matrix consists mainly of weakly birefringent clay intergrown with moderate amounts of a slightly more birefringent fibrous clay. Minor amounts of muscovite/sericite also form disseminated small flakes below 0.05 mm long. A vague preferred orientation approximately parallel to the banding is evident in the fibrous phyllosilicate.

The detrital quartz grains tend to be concentrated in bands up to 0.5 mm wide. Most of the detrital quartz grains are below 0.03 mm in size although a few larger grains ranging up to 0.1 mm wide are disseminated through the rock.

Chlorite tends to be concentrated in discontinuous vein-like bands ranging up to 0.1 mm wide which are oriented parallel to the banding or transect the banding at a low angle. The chlorite forms small flakes with a pleochroic green colour and low anomalous birefringence. Some of the chlorite veinlets also contain coarser grained quartz which could be of secondary origin.

Opaques are disseminated through the rock as very small grains below 0.05 mm in size. Locally opaques tend to be concentrated within narrow discontinuous bands or lamellae.

This is an argillaceous detrital sediment containing small amounts of quartz-rich silt-sized detritus.

SAMPLE: 6528 RS425: TS46129

Rock Name:
Quartzite/Shale

Hand Specimen:
This is a banded rock containing a wide pale grey band in contact with a darker greenish-grey band which also exhibits finer banding with mild colour variations. Ovoid sulphide patches up to a few millimetres wide are disseminated through the paler coloured band.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	60
Argillaceous matrix	30
Calcite	3
Feldspar	3
Tourmaline	Tr
Zircon	Tr
pyrite ovoids → Opaques	5

This is a banded rock with a variable texture being comprised mainly of detrital quartz grains intergrown with clay-rich bands. The largest pale grey band noted in hand specimen consists of an angular mosaic of quartz grains ranging in size between 0.2 and 0.4 mm. The finer-grained bands consist mainly of weakly birefringent clay intergrown with a fibrous more birefringent clay as well as some finely divided sericite flakes. These argillaceous bands have irregular discontinuous shapes and tend to be intergrown with narrower bands containing finer-grained, quartz-rich detritus. Many of the quartz-rich bands intergrown with the shale have a grain size of about 0.05 to 0.1 mm with only a smaller number of detrital grains ranging up to 0.3 mm wide.

The coarser grained quartz-rich band forms an interlocking mosaic with the strong development of overgrowth quartz. Many of the quartz grains exhibit remnant rounded shapes but these have been modified by recrystallisation and the development of overgrowth quartz. This band contains ovoid to round opaque patches typically between 0.5 and 1 mm in size which would represent the pyritic structures noted in hand specimen.

The finer-grained quartz tends to exhibit angular to subangular shapes. Minor feldspar including polysynthetically twinned plagioclase and grid-iron twinned microcline is intergrown with both the finer-grained quartz and coarser grained quartz. Traces of tourmaline and zircon were also noted as small detrital grains typically below 0.2 mm wide.

The clay bands tend to have a vague foliated character often oriented at a high angle to the banding which is generally defined by a preferred orientation of the fibrous, slightly more birefringent clay. Minor amounts of clay occur interstitial to the coarser quartz grains in the quartz-rich portion of the rock. Some of these clay patches are up to 1 mm in size but most are much smaller rarely exceeding 0.2 mm in size.

Calcite is disseminated through the rock as small grains and crystals ranging up to 0.2 mm in size which typically occur interstitially between the detrital quartz grains. Minor calcite is also present as narrow fracture and vein fillings below 0.1 mm wide. Calcite also occurs to a much lesser extent in the cores of the round sulphide structures.

The most striking opaque mineral in this rock are the large ovoid structures associated with the quartz-rich sandstone. Other opaques are disseminated through the rock as anhedral grains and aggregates and interstitial fillings. There is a tendency for these opaques to be concentrated in some clay-rich bands where they tend to concentrate within discontinuous lamellae.

This is a detrital sedimentary rock ranging in character from a quartz-rich sandstone to a shale. An unusual feature of this rock is the presence of rounded pyritic structures within the quartz-rich sandstone.

SAMPLE: 6528 RS426: TS46130

Rock Name:
Quartzite

Hand Specimen:
A pale grey rock transected by some narrow dull white fractures up to about 1 mm wide. The rock also contains round, yellow sulphide patches up to about 1 mm in diameter.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	90
Feldspar	3
Clay	2
Carbonate	1
Tourmaline	Tr
Zircon	Tr
Opaques	3

This is a quartz-rich rock containing detrital quartz grains ranging between 0.15 and 0.8 mm in size which form a very strongly interlocking mosaic. Some of the quartz grains exhibit well-rounded shapes with the development of overgrowth quartz while others have irregular, angular shapes possibly due to recrystallisation. Minor detrital feldspar comprised mainly of untwinned potash feldspar along with smaller amounts of grid-iron twinned microcline and polysynthetically twinned plagioclase is disseminated through the rock as detrital grains similar in size to the detrital quartz grains. Traces of tourmaline and zircon also form small detrital grains up to 0.2 mm wide.

Within vague bands the quartz has a much finer grain size and appears to have a deformed, granulated texture. Some of these bands contain concentrations of carbonate and finely divided opaques. Minor carbonate is also disseminated through the rock and angular interstitial fillings up to 0.2 mm wide.

Minor clay occurs interstitial to some of the detrital quartz grains. Most of the clay has a very low birefringence and a pale green colour and could be chloritic material. In some of the more deformed appearing areas a darker green phyllosilicate is also locally present as is a very weakly birefringent mineral with high relief which is also thought to be a clay or chloritic mineral.

As with the quartzite portion of sample 6528 RS425 this sample also contains round to ovoid pyritic patches up to about 1 mm in diameter. Opaques are also disseminated through the rock as anhedral to subhedral grains and aggregates below 0.1 mm wide. Many opaques tend to be concentrated in narrow discontinuous bands with finely granulated quartz.

This is a detrital quartz-rich sediment with a well indurated, recrystallised appearing textue. This sample contains pyritic ovoid bodies similar to those in quartzite sample 6528 RS425.

SAMPLE: 6528 RS427: TS46131

Rock Name:
Siltstone

Hand Specimen:
A strongly banded rock on a scale ranging up to about 5 mm wide with a medium to dark grey colour. A very dark green vein approximately 1 mm wide transects the bedding at a high angle.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	50
Clay	40
Feldspar	4
Chlorite	2
Tourmaline	Tr
Zircon	Tr
Opaques	4

This sample is comprised mainly of detrital quartz grains distributed through an argillaceous matrix. The banding which was noted in hand specimen is due to variations in the proportions and grain size of detrital quartz in different bands. Some bands up to approximately 1 mm wide contain coarser grained sand-sized quartz ranging up to 0.5 mm wide while other bands contain fine sand to silt-sized quartz. The finer-grained quartz bands contain concentrations of argillaceous material and some bands consist mainly of argillaceous material.

The coarser grained quartz typically has a subangular to rounded shape and is concentrated in narrow bands up to about 1 mm wide. Some of this quartz tends to form an interlocking mosaic with the weak development of overgrowth quartz and some possible recrystallisation. The finer-grained quartz generally has a more angular shape and is intergrown with large amounts of argillaceous material. Minor detrital feldspar is intergrown with some of the quartz and is best seen in the coarser grained quartz bands. This feldspar includes polysynthetically twinned plagioclase and grid-iron twinned microcline. Traces of tourmaline and zircon were also noted as small detrital grains up to 0.1 mm wide.

The argillaceous material consists of weakly birefringent clay intergrown with a fibrous, slightly more birefringent phyllosilicate and minor amounts of very finely divided muscovite/sericite flakes. The fibrous phyllosilicates and muscovite/sericite exhibit a strong preferred orientation approximately parallel to the mineralogical banding. The rock is transected by a chlorite vein approximately 0.5 mm wide which would represent the dark green vein noted in hand specimen. The chlorite in this vein has a pleochroic green colour and anomalous blue birefringence. This chlorite generally forms a fibrous, traverse aggregate within the vein. Narrow veinlets locally depart from this larger vein. Locally this chlorite vein contains concentrates of quartz as crystals ranging up to 0.1 mm wide.

Opaques are disseminated through the rock as small grains and aggregates which are generally below 0.1 mm wide. The opaques tend to be concentrated in clay-rich areas where they are locally concentrated in very narrow discontinuous lenses.

This is a fine-grained detrital sediment comprised mainly of fine sand to silt-sized quartz and a clay component.

SAMPLE: 6528 RS428: TS46132

Rock Name:
Siltstone with Sandstone Bands

Hand Specimen:
A greenish-grey coloured rock with a fine grain size containing an irregular band with a pale grey colour and a coarser grain size. Within localised areas the pale grey band contains concentrations of round sulphide structures up to about 1 mm in diameter.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	60
Argillaceous matrix	30
Feldspar	3
Carbonate	2
Calcite	Tr-1
Chlorite	Tr
Tourmaline	Tr
Zircon	Tr
Opaques	4

This sample consists mainly of a fine-grained sediment comprised of fine sand to silt-sized quartz-rich detritus intergrown with an argillaceous matrix. A banding on a scale ranging up to several millimetres wide is produced by variations in the proportions and grain size of a detrital quartz. One coarser grained band comprised of quartz grains ranging up to 0.8 mm in size is also present in this sample.

The argillaceous matrix consists mainly of weakly birefringent clay intergrown with a fibrous, slightly more birefringent material. Some finely divided muscovite/sericite flakes are also distributed through the argillaceous matrix. The sericite and fibrous clay exhibit at least two preferred orientations, one of which is approximately parallel to the mineralogical banding. In the coarser grained band some interstitial clay including a pale green, weakly pleochroic chlorite is present.

The quartz in the coarser grained band tends to exhibit rounded to subrounded shapes which have been modified by the development of overgrowth quartz and probable recrystallisation forming a well indurated mosaic. Some finer-grained quartz ranging up to 0.1 mm in size is locally concentrated in bands within argillaceous layers. This finer-grained quartz also tends to exhibit subrounded to subangular shapes which have been modified by recrystallisation.

Minor feldspar is associated with the detrital quartz as grains of similar size and shape. The feldspar includes polysynthetically twinned plagioclase and grid-iron twinned microcline. Traces of tourmaline and zircon also form small detrital grains.

The coarser grained band contains concentrations of carbonate as angular interstitial fillings up to 0.5 mm in size. Most of the carbonate is unaffected by the alizarin red-S stain suggesting that it is dolomite. Minor calcite which is stained by this solution also occurs as angular interstitial fillings up to 0.2 mm wide.

Round opaque structures similar to those in some previously described quartzites are concentrated within one area in the quartzite band. Opaques are also disseminated through the rock as small grains and aggregates which tend to be concentrated in the argillaceous bands. Many opaques tend to be concentrated along narrow discontinuous bands or lamellae oriented parallel to the general mineralogical banding.

This is a fine-grained detrital sediment containing some coarser grained sand layers. These sand layers contain localised concentrations of pyritic ovoids similar to those in some previously described quartzites.

SAMPLE: 6528 RS429: TS46133

Rock Name:
Siltstone with Sandstone Lamellae

Hand Specimen:
A very fine-grained, medium grey rock with a weakly developed fissile foliation. A vague banding is produced by narrow discontinuous bands and lamellae up to 1 mm wide with a slightly darker colour.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	50
Argillaceous matrix	45
Feldspar	1
Zircon	Tr
Tourmaline	Tr
Opaques	4

This sample consists mainly of an argillaceous matrix through which fine sand to silt-sized detrital quartz grains are disseminated. The rock has a banded character produced by variations in the proportions of quartz and argillaceous material within the siltstone as well as the presence of some coarser grained sandy bands up to 1 mm wide. The coarser grained sandy bands in particular tend to have highly irregular shapes with a discontinuous character. The finer-grained quartz bands also tend to have a somewhat undulose discontinuous character. It is thought that the character of the banding is due mainly to soft sediment deformation.

The argillaceous matrix consists of weakly birefringent clay intergrown with fibrous, slightly more birefringent clay and small amounts of finely divided muscovite/sericite flakes. The fibrous clay in particular tends to exhibit at least two weakly developed preferred orientations, one of which appears to be close to the direction of the mineralogical banding.

The coarser grained quartz has a maximum grain size of 0.5 mm and forms an interlocking mosaic of slightly modified rounded to subrounded grains. The finer-grained quartz also tends to have a somewhat recrystallised appearing texture. In addition to the quartz minor detrital feldspar including polysynthetically twinned plagioclase and grid-iron twinned microcline form detrital grains. Traces of tourmaline and zircon also form small detrital grains up to 0.1 mm wide.

The coarser grained quartz bands contain some interstitial clay as angular fillings up to 0.3 mm wide. This clay tends to have a pale green colour and low birefringence suggesting that it is chlorite.

Opaques are disseminated through the rock as small grains and aggregates which rarely exceed 0.1 mm in size. The opaques tend to be concentrated in discontinuous lamellae oriented parallel to the mineralogical banding.

This is a fine-grained detrital sediment containing some narrow coarser grained quartz-rich lamellae.

SAMPLE: 6528 RS430: TS46134

Rock Name:
Siltstone with Shale Lamellae

Hand Specimen:
A finely banded rock containing discontinuous bands and lenses with a greenish-grey colour separated by bands and fine lamellae with a dark red colour. The rock has a moderately well developed fissile foliation parallel to the banding.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Argillaceous matrix	50
Quartz	45
Feldspar	2
Tourmaline	Tr
Zircon	Tr
Opaques	3

This is a banded rock comprised of alternating siltstone and shale bands on a scale ranging up to 2 mm wide. Some of the bands have a vague gradational character and could represent graded bedding while others have a sharp contact between the siltstone and shale. The banding is generally relatively undeformed although locally it has a contorted and discontinuous character. This disturbance of the banding is thought to represent soft sediment deformation.

The siltstone-rich bands contain detrital quartz grains ranging up to 0.1 mm wide although many siltstone bands contain detrital quartz grains with a much finer grain size. Most of the detrital quartz has angular to subangular shapes and is intergrown with moderate amounts of finely divided clay. A few lenses comprised of coarser grained quartz with a typical grain size of 0.1 mm are also present in the rock. Minor feldsapr also occurs as detrital grains up to 0.1 mm wide and includes at least some polysynthetically twinned plagioclase. Traces of tourmaline and zircon form small disseminated crystals.

The shale bands consist mainly of clay much of which has a translucent, reddish-brown iron stained colour. Most of the shale bands consist of a fibrous moderately birefringent clay which exhibits at least one vague preferred orientation at a high angle to the mineralogical banding. Minor finely divided muscovite/sericite is also present in the shale and siltstone bands. The coarser grained siltstone and fine-grained sandstone bands tend to have interstitial clay with a pale green colour which could represent chloritic material.

Opaques are disseminated through the rock as small grains below 0.1 mm in size which tend to be concentrated in the clay bands. Many of the opaques form very narrow discontinuous bands or lamellae.

This is a fine-grained detrital sediment comprised of alternating siltstone and shale lamellae.

SAMPLE: 6528 RS431: TS46135

Rock Name:
Sandstone with (?)Dolomite Bands

Hand Specimen:
Most of this sample consists of a fine-grained well indurated rock with a medium grey colour. One margin of the core interval contains some dull white to pale tan bands up to approximately 5 mm wide. Testing of the sample with dilute hydrochloric acid produces only a very mild reaction indicating that the carbonate is not calcite.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	65
Carbonate	25
Feldspar	5
Chlorite/clay	2
Muscovite/sericite	Tr-1
Tourmaline	Tr
Zircon	Tr
Opaques	2

Most of this sample consists of a well indurated mosaic of detrital quartz grains which range in size from 0.1 to 0.7 mm. The quartz grains form an interlocking mosaic produced by recrystallisation and the development of overgrowth quartz. Many of the quartz grains still exhibit remnant rounded shapes although some quartz grains have angular to subangular shapes.

The portion of the rock which contains white to tan coloured bands consists of bands of finer-grained quartz cemented by finely granular carbonate which would represent the white coloured bands and finely granular carbonate bands which would represent the pale tan bands. The carbonate in these bands typically has a very fine grain size below 0.03 mm although some coarser grained carbonate with a grain size of 0.2 mm is present. The coarser grained carbonate tends to occur in the quartz bands. The carbonate is very weakly stained by the alizarin red-S solution but testing of the hand specimen and the general weakly stained character indicate that the carbonate is not calcite and is mostly likely dolomite. This carbonate also occurs in the quartzite adjacent to the carbonate bands as interstitial fillings up to 0.2 mm wide. This carbonate typically occurs as interstitial fillings only within a few millimetres of the finer-grained quartz band with carbonate cement.

Although quartz is the major detrital component minor feldspar including untwinned orthoclase and polysynthetically twinned plagioclase is also present. The detrital feldspar grains range up to 0.5 mm in size. Traces of tourmaline and zircon also form small detrital grains which rarely exceed 0.1 mm in size. Some moderately well-developed muscovite flakes up to 0.2 mm long are disseminated through the rock and could be of detrital origin.

A narrow, undulose vein-like structure filled with pale green chlorite and a fibrous birefringent phyllosilicate is locally present in the thin section. The chlorite exhibits very low anomalous birefringence and forms moderately well-developed flakes up to 0.1 mm wide. Opaques also tend to be concentrated in this irregular vein-like structure.

Opaques are disseminated through the rock as small grains and aggregates up to 0.1 mm wide. Opaques in particular tend to be concentrated near the contact of the finer-grained and carbonate-cemented bands with other lithologies. Locally opaques also tend to be concentrated within very vague bands in the quartzite.

This is a quartz-rich detrital sedimentary rock somewhat similar to the previously described quartzites which contains some carbonate bands as well as some bands comprised of finer-grained detritus cemented by interstitial carbonate. The carbonate in this sample is most likely dolomite.

SAMPLE: 6528 RS432: TS46136

Rock Name:
Sandstone/(?)Dolomite

Hand Specimen:
This sample consists of a contact zone between a well indurated fine-grained rock with a pale grey colour and an essentially massive darker reddish-brown rock. The contact zone between these two lithologies is approximately 1½ cm wide and contains angular clasts with a green to reddish-brown colour in a pale grey to dull white fine-grained matrix. Testing with dilute hydrochloric acid produces only a very mild reaction indicating calcite is not present.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	45
Carbonate	35
Clay	13
Feldspar	2
Muscovite/sericite	1
Tourmaline	Tr
Zircon	Tr
Opaques	4

The thin section was cut across the contact between the two lithologies noted in hand specimen so that the above mineral proportions largely reflect the proportions of the different lithologies included in thin section. The pale grey portion of the rock is comprised mainly of an interlocking mosaic of detrital quartz grains ranging up to 0.8 mm in size. This portion of the sample is similar to many of the previously described quartzites exhibiting well-developed overgrowths on rounded grains as well as a recrystallised appearing texture.

The very fine-grained reddish-brown portion of this sample consists of small carbonate crystals about 0.05 mm in size intergrown with minor amounts of interstitial opaque to reddish-brown limonitic material. The carbonate is only weakly stained by the alizarin red-S solution which along with its reaction to hydrochloric acid suggests that it is dolomite. Minor quartz and traces of feldspar are disseminated through the carbonate as small, detrital grains ranging up to 0.1 mm in size. Elongate muscovite flakes up to 0.3 mm long are also present at trace levels and are most likely of detrital origin.

The contact zone between the quartzite and dolomite consists mainly of quartz grains cemented by an interstitial finely granular carbonate matrix. Within this contact zone are angular clasts and irregular patches of clay which would represent the reddish-brown to grey fragments in hand specimen. These clay-rich patches generally consist of weakly birefringent clay intergrown with minor amounts of fibrous, slightly more birefringent clay. Clay is also locally concentrated as irregular discontinuous bands in this zone.

The quartzite contains some interstitial carbonate as angular interstitial fillings up to 0.3 mm in size. Although quartz is the major detrital component in the quartzite minor amounts of feldspar and traces of tourmaline and zircon are also present.

Opaques are disseminated through the rock as small grains ranging up to 0.1 mm in size. The opaques in particular tend to be concentrated in the clay patches but they also occur interstitially in the quartzite and as disseminations through the dolomitic rock. The contact between the dolomite and the dolomite-cemented sandstone has a concentration of opaque material producing a translucent to opaque band which could represent either limonitic material or iron stained clay. Some of the argillaceous patches and bands also have concentrations of opaque to translucent limonitic material around their outer margins.

This thin section includes a contact between a quartz sandstone and a carbonate-rich rock believed to be dolomite. The contact zone is approximately 1½ cm thick and consists of quartz-rich sand cemented by dolomite as well as angular patches and clasts of argillaceous material.

SAMPLE: 6528 RS433: TS46137

Rock Name:
Sandstone with Siltstone Bands

Hand Specimen:
This core interval has a banded character containing pale grey to dull white bands up to a few centimetres in size bounded by much finer-grained, darker greenish-grey bands. The coarser grained pale grey bands also contain discontinuous darker green lenses and lamellae.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	60
Chlorite	20
Clay	13
Feldspar	3
Muscovite/sericite	1
Carbonate	Tr-1
Tourmaline	Tr
Zircon	Tr
Opaques	2

This sample consists mainly of detrital quartz grains ranging up to 0.5 mm in size which form a strongly interlocking mosaic. Many of the quartz grains have rounded detrital shapes but exhibit the strong development of overgrowth quartz to produce the interlocking texture now present. This quartzitic sandstone contains a significant proportion of a pale green, weakly pleochoric phyllosilicate with very low birefringence which has been termed chlorite. This chlorite tends to be concentrated in ovoid pellets up to 0.5 mm in diameter although minor amounts also form angular interstitial fillings which could represent deformed pellets. To some extent this chloritic material is concentrated in vague discontinuous bands and lenses which account for the banded character of this portion of the rock in hand specimen.

The darker grey, finer-grained portions of the rock have been termed siltstone and consist of very small quartz grains below 0.05 mm in size intergrown with an argillaceous matrix. The matrix consists of weakly birefringent clay intergrown with a fibrous, slightly more birefringent clay and some finely divided muscovite/sericite flakes. A preferred orientation is defined by the fibrous clay and muscovite/sericite flakes which is oriented approximately parallel to the banding. Narrow finer-grained layers up to several millimetres wide occur within the sandstone. These layers consist of finer-grained quartz ranging up to 0.1 mm in size intergrown with moderate amounts of argillaceous material. The argillaceous material in particular tends to be concentrated in narrow lamellae below 0.3 mm wide which in many cases are bounded by scalloped, microstylolitic margins.

Minor feldspar including polysynthetically twinned plagioclase is disseminated through the rock as detrital grains up to 0.4 mm wide. Traces of tourmaline and zircon form small detrital grains below 0.1 mm wide. Minor carbonate was noted locally as angular interstitial fillings between quartz grains.

Opaques form disseminated grains up to 0.2 mm wide. Finely divided opaques tend to be concentrated in the argillaceous bands. Opaques also occur locally as very narrow concentrations around the outer margins of some chlorite patches and pellets.

This is a detrital sedimentary rock containing green phyllosilicate pellets believed to be chlorite rather than true glauconite. The rock also contains finer-grained detrital bands with a high clay component.

SAMPLE: 6528 RS434: TS46138

Rock Name:
Sandstone

Hand Specimen:
This is a banded rock with a grey to reddish-brown colour comprised of paler grey bands up to 1 cm wide separated by narrower darker reddish-brown bands up to about 2 mm wide.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	70
Carbonate	10
Chlorite	10
Feldspar	5
Tourmaline	Tr
Muscovite	Tr
Biotite	Tr
Opaques	5

This sample consists mainly of detrital quartz grains ranging up to 0.8 mm in size which form an interlocking mosaic. Many of the quartz grains have rounded detrital shapes which have been modified by the strong development of overgrowth quartz producing the present interlocking texture. Included with the detrital quartz are very small amounts of chalcedony which forms detrital grains with a fibrous texture. Small amounts of feldspar including grid-iron twinned microcline and polysynthetically twinned plagioclase also forms detrital grains up to 0.5 mm in size. Rounded, detrital tourmaline grains up to 0.2 mm wide are also disseminated through the rock.

This sample contains some pellets of a green phyllosilicate believed to be chlorite. These pellets range up to 0.4 mm in size and tend to have ovoid shapes. Some chlorite also forms angular interstitial fillings between the detrital quartz grains and could represent deformed pellets. In general these chlorite pellets are concentrated in bands up to several millimetres wide. The chlorite-rich bands also contain concentrations of interstitial opaque material and would represent the narrower darker coloured bands noted in hand specimen.

Carbonate occurs mainly as angular interstitial fillings between the detrital quartz grains. Most of these carbonate patches are below 0.2 mm wide although some carbonate patches up to 0.8 mm wide are present. Carbonate also tends to be concentrated as intergrowths with some chloritic pellets and appears to be a partial replacement product of some pellets. It is possible that some of the interstitial carbonate could also represent a replacement product of chlorite.

Traces of muscovite and biotite occur as very small flakes below 0.05 mm long which are totally included within detrital quartz grains. Opaques are disseminated through the rock as small grains and angular interstitial fillings which tend to be concentrated in chlorite-rich bands. Opaques are also locally concentrated around the outer margins of some chlorite pellets.

This is a quartz-rich detrital sediment containing narrow bands with concentrations of chloritic material and interstitial opaques. The rock also contains some carbonate which at least in part is a replacement product of chloritic material.

SAMPLE: 6528 RS435: TS46139

Rock Name:
Fine-Grained Sandstone

Hand Specimen:
This is a somewhat variable, banded rock comprised of pale grey to darker greenish-grey and reddish-brown bands on a scale ranging up to about 5 mm in width. Locally the banding has a somewhat irregular, weakly contorted or cross-bedded character.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	75
Chlorite	10
Feldspar	5
Clay	3
Carbonate	2
Muscovite/sericite	1
Tourmaline	Tr
Zircon	Tr
Opaques	4

This is a banded rock comprised mainly of detrital quartz grains whose banding is produced by variations in the grain size of the quartz within different bands. Most of the quartz has a grain size of about 0.1 to 0.2 mm although some coarser grained bands with a grain size ranging between 0.3 and 0.6 mm are also present. The rock also contains some narrow bands up to approximately 1 mm wide with a much finer grain size and significant proportion of finely divided clay. The quartz typically forms an interlocking mosaic produced by the strong development of overgrowth quartz as well as possible recrystallisation. Some quartz grains exhibit rounded shapes which have been modified by the development of overgrowth quartz while other quartz grains particularly some of the finer-grained quartz exhibits angular to subangular shapes.

Chlorite is intergrown with the quartz as round to ovoid pellets and irregular patches up to 0.5 mm in size. It is considered possible that at least some of the chlorite patches could represent deformed pellets. The chlorite has a pleochroic green colour and very low birefringence. Some of the chlorite pellets exhibit concentrations of opaque material around their outer margins and a few also show partial replacement by finely granular quartz or cherty silica. There is a tendency for the pellets to be concentrated in discontinuous bands further adding to the banded character of the rock.

Feldspar is disseminated through the rock as detrital grains ranging up to 0.4 mm in size. The feldspar consists of polysynthetically twinned plagioclase, grid-iron twinned microcline and untwinned orthoclase. Traces of tourmaline and zircon form small detrital grains below 0.2 mm wide. The rock contains some moderately well-developed muscovite flakes ranging up to 0.15 mm in length which are also most likely of detrital origin.

Some narrow bands ranging up to 1 mm in width contain concentrations of interstitial clay. This clay has a very weakly birefringent character. In some cases minor amounts of an interstitial green clay of possible chloritic character is also present.

Opaques occur mainly as anhedral interstitial fillings and to a lesser extent as anhedral to subhedral disseminated grains. The opaques also tend to be concentrated in narrow bands up to 1 mm wide and at least some of these opaque-rich bands would probably represent the red bands noted in hand specimen.

This is a detrital sedimentary rock comprised mainly of detrital quartz containing some finer-grained bands. In general this rock is finer grained than most of the previously described quartz-rich sandstones.

SAMPLE: 6528 RS436: TS46140

Rock Name:
Sandstone

Hand Specimen:
A well indurated, fine-grained rock with a pale grey colour. This core interval also contains some irregular patches and lenticular bodies as well as a band along one margin with a much finer grain size and a darker greenish-grey colour.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	75
Clay	13
Feldspar	5
Carbonate	3
Chlorite	2
Tourmaline	Tr
Muscovite/sericite	Tr
Zircon	Tr
Opaques	2

This sample consists mainly of detrital quartz grains ranging between 0.15 and 0.8 mm in size which form an interlocking mosaic. The quartz grains tend to exhibit rounded shapes which have been modified by the strong development of overgrowth quartz to produce the interlocking texture. Minor detrital feldspar including untwinned orthoclase, polysynthetically twinned plagioclase and grid-iron twinned microcline also form detrital grains up to 0.3 mm in size.

The darker grey finer-grained band noted along one margin of the hand specimen consists mainly of a siltstone or shale. This band contains fine sand to silt-sized quartz particles distributed through an argillaceous matrix comprised of weakly birefringent clay and fibrous, slightly more birefringent clay. The birefringent clay exhibits a preferred orientation approximately parallel to the banding.

The rock contains another lens comprised mainly of weakly birefringent clay intergrown with carbonate. Locally this carbonate forms granular aggregates up to 1.5 mm in size but most of the carbonate forms small disseminated grains. A small proportion of this carbonate exhibits vague rhomb shapes. Minor chlorite also occurs in this argillaceous lens as narrow veinlets below 0.1 mm wide. This chlorite has a pleochroic green colour and very low, anomalous birefringence.

Minor chlorite is locally intergrown with the sandstone as small pellets or angular interstitial fillings up to 0.4 mm in size. This chlorite also exhibits a green colour and low birefringence. Minor carbonate or finely granular cherty quartz locally occurs as a partial replacement product of the chlorite pellets. Some ovoid patches of finely granular, cherty textured quartz could represent completely silicified chlorite pellets.

Traces of tourmaline and zircon form small detrital grains up to 0.2 mm wide. The rock contains some muscovite flakes up to 0.15 mm wide which are most likely of detrital origin. Opaques form anhedral disseminated grains up to 0.1 mm wide. Finely divided opaques tend to be concentrated in the siltstone bands and locally form small, lenticular shaped concentrations.

This is a quartz-rich detrital sediment containing some narrow argillaceous lamellae with fine sand to silt-sized quartz-rich detritus.

SAMPLE: 6528 RS437: TS46141

Rock Name:
Sandstone

Hand Specimen:
An irregularly banded rock comprised of pale grey bands intergrown with darker grey to greenish-grey bands.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	65
Clay	15
Chlorite	12
Feldspar	5
Carbonate	1
Muscovite/sericite	1
Tourmaline	Tr
Zircon	Tr
Opaques	1

This sample consists mainly of detrital quartz grains ranging up to 0.5 mm in size which form a recrystallised mosaic produced by the strong development of overgrowth quartz. Many of the detrital quartz grains have rounded shapes which have been modified by overgrowth quartz development. Other quartz grains exhibit subangular to angular shapes. In addition to the quartz the rock contains irregular lenses comprised of argillaceous material and fine sand to silt-sized quartz-rich detritus. These lenses would represent the darker coloured bands and lenses noted in hand specimen.

Although quartz is the major detrital component, minor feldspar also occurs as angular to subangular detrital grains up to 0.5 mm wide. Traces of tourmaline and zircon are also present as small detrital grains below 0.2 mm wide. The rock contains small amounts of finely divided muscovite/sericite as flakes up to 0.15 mm long which are also most likely of detrital origin. Traces of muscovite were also noted as small flakes totally included within detrital quartz grains.

Chlorite is disseminated through the rock as pellets and interstitial fillings ranging up to 0.5 mm wide. The chlorite tends to be concentrated in vague bands up to several millimetres wide. The chlorite typically has a pale green, weakly pleochroic colour and very low birefringence. Minor carbonate also occurs as angular interstitial fillings between the detrital quartz grains.

The clay lenses in this rock consist mainly of weakly birefringent clay intergrown with minor amounts of more birefringent fibrous clay and very small muscovite/sericite flakes. Most of the clay lenses have a highly discontinuous and somewhat contorted character. The elongate clay minerals generally exhibit a preferred orientation parallel to the general banding.

Opaques are disseminated through the rock as anhedral grains and aggregates which generally occur intergrown with the interstitial chlorite or clay-rich lenses.

This is a quartz-rich detrital sedimentary rock with a strongly banded character produced by discontinuous argillaceous lenses as well as some bands which contain concentrations of chlorite.

SAMPLE: 6528 RS438: TS46142

Rock Name:
Fine-Grained Sandstone

Hand Specimen:
This is a lamellar banded rock on a scale of about 1 to 3 mm comprised of alternating pale grey and darker reddish-brown coloured bands.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Quartz	80
Feldspar	13
Carbonate	1
Muscovite/sericite	1
Tourmaline	Tr
Zircon	Tr
Opaques	5

This sample consists mainly of a finely granular quartz mosaic with a typical grain size of about 0.1 to 0.2 mm. The quartz forms a recrystallised appearing interlocking mosaic with the strong development of overgrowth quartz. Some bands contain concentrations of ovoid structures up to 0.3 mm in diameter which now consist of granular quartz. These ovoid structures are delineated by rims of opaque material and in some cases the granular quartz is optically continuous over the boundary of the ovoid particle. These ovoid particles are thought to represent silicified pellets, possibly of chloritic material like the chlorite pellets in some previously described sandstones. These bodies tend to be concentrated in bands up to a few millimetres wide which also tend to contain concentrations of interstitial opaque material. These bands would represent the reddish-brown bands noted in hand specimen.

Feldspar is also disseminated through the rock as angular detrital grains up to 0.2 mm in size. The feldspar consists of untwinned orthoclase, polysynthetically twinned plagioclase and grid-iron twinned microcline. Traces of tourmaline and zircon form small detrital grains up to 0.15 mm wide. Small muscovite/sericite flakes are also disseminated through the rock and are most likely of detrital origin.

Minor carbonate is locally present as angular interstitial fillings up to 0.2 mm wide located between the quartz grains. Some carbonate also tends to form ovoid-shaped bodies and could represent pellets which have been replaced by carbonate.

Opaques occur mainly as interstitial fillings concentrated within bands noted earlier. Some opaques also form anhedral disseminated grains and aggregates up to 0.15 mm wide.

This is a quartz-rich detrital sediment with a well banded texture produced by bands containing concentrations of interstitial opaque material which would represent the reddish bands in hand specimen. This rock shows evidence of strong silicification with the development of both overgrowth quartz and ovoid bodies believed to represent silicified pellets. An unusual feature of the silicified pellets is their coarsely granular texture and a tendency for some of the grains within the pellet to be in optical continuity with quartz outside the pellet margin.

SAMPLE: 6528 RS439: TS46143

Rock Name:
Silty Shale

Hand Specimen:
This is an essentially grey coloured rock with a weakly developed fissile foliation. The rock has a banded character produced by discontinuous lenses and narrow bands with a pale greenish-grey colour separated by pale reddish-grey coloured bands.

Thin Section:
An optical estimate of the constituents gives the following :

	%
Argillaceous matrix	50
Quartz	35
Chlorite	8
Muscovite/sericite	5
Feldspar	1
Carbonate	Tr
Zircon	Tr
Tourmaline	Tr
Opaques	1

This is a very fine-grained detrital rock with a banded texture produced by alternating clay-rich and slightly coarser grained sand and silt-rich bands. The banding is generally on a scale of approximately 0.5 to several millimetres. The clay-rich bands typically contain small amounts of very fine sand to silt-sized quartz-rich detritus. The detrital quartz-rich bands generally contain quartz grains of variable grain sizes with some finer-grained quartz-rich bands having a maximum grain size of 0.1 mm and some coarser grained quartz-rich bands having a maximum grain size of 0.4 mm. The quartz-rich bands generally have a somewhat more discontinuous character and are narrower than the argillaceous bands.

The clay-rich bands consist of weakly birefringent clay intergrown with fibrous, slightly more birefringent clay which typically exhibits a preferred orientation approximately parallel to the mineralogical banding. A secondary foliation oriented at a high angle to the mineralogical banding is also evident in the clay-rich bands. Minor muscovite/sericite forms small flakes up to 0.1 mm long which occur both in the clay-rich bands and in the fine-grained quartz-rich bands. This muscovite/sericite is most likely of detrital origin. The rock contains some greenish coloured pellets up to 0.3 mm in size which have been termed chlorite although it is possible that they could represent glauconite pellets. Some similar chloritic phyllosilicate also locally occurs as interstitial fillings between detrital quartz grains.

Some of the quartz-rich bands have a strongly recrystallised texture with the development of overgrowth quartz and this is particularly well-developed in the coarser grained bands. The finer-grained bands generally have a higher proportion of interstitial clay and chlorite as well as a higher proportion of small muscovite/sericite flakes.

Minor feldspar is intergrown with the detrital quartz as small grains up to 0.2 mm wide. Traces of tourmaline and zircon also form small detrital grains. Carbonate was noted locally as interstitial fillings between some quartz grains.

Opaques are disseminated through the rock as small grains up to 0.1 mm wide.

This is an argillaceous detrital sedimentary rock with a strongly banded character.

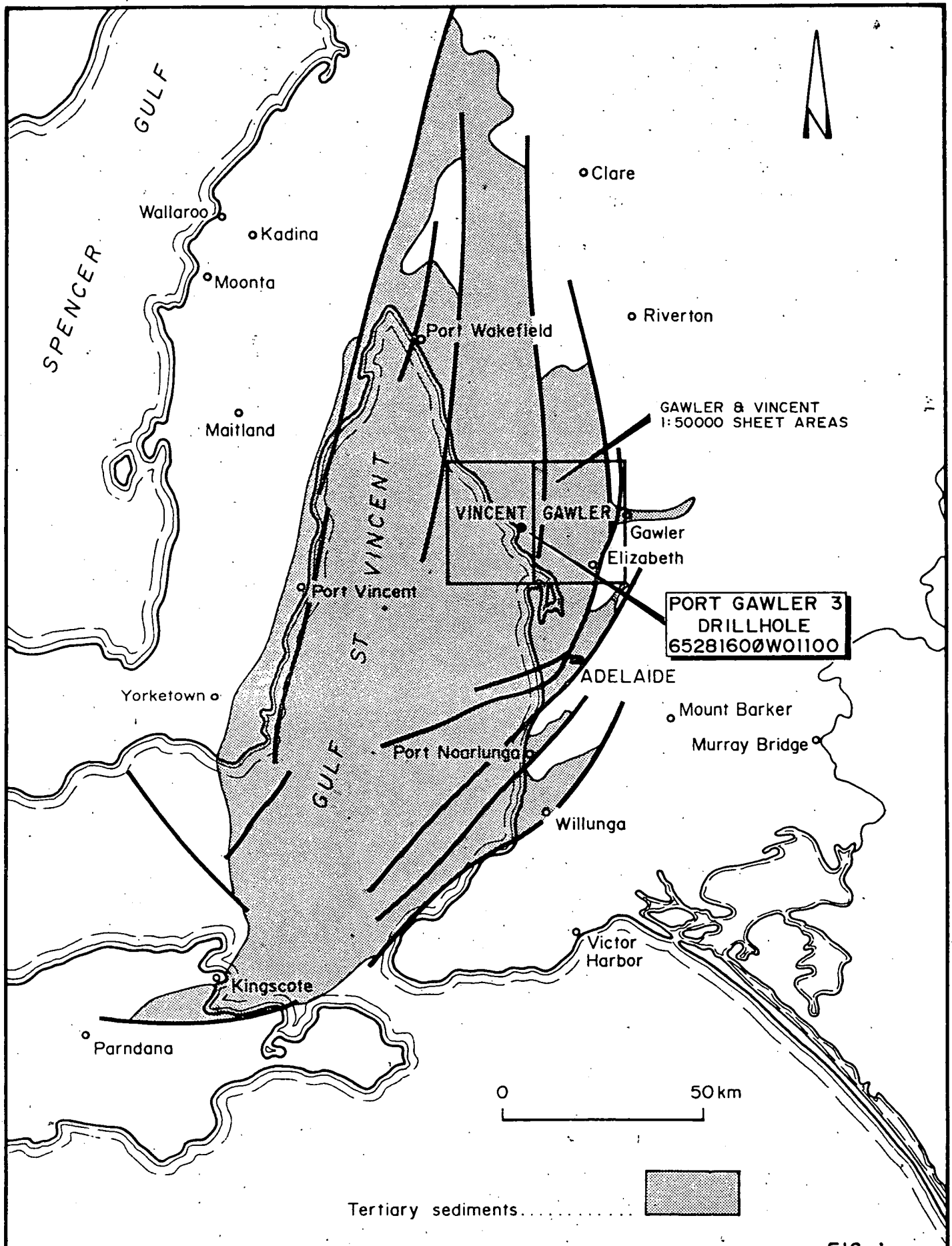


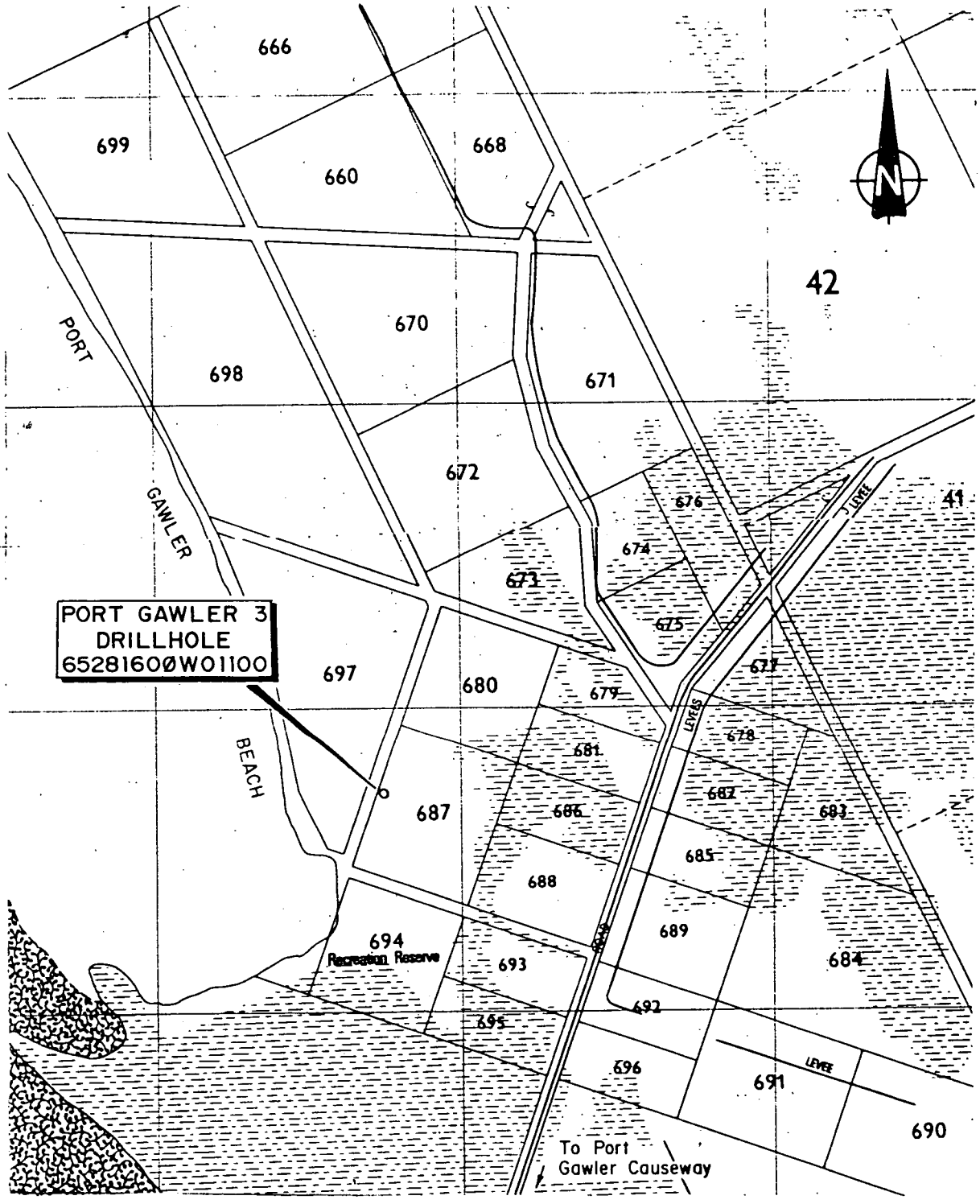
FIG. 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED A. Belperio	C.D.O. 21.12.87 DATE
DRAWN R. Bird	SCALE As shown
DATE Sept. 1987	PLAN NUMBER S19601
CHECKED	

PORT GAWLER 3 WELL COMPLETION REPORT
SEC. 687 HUNDRED OF PORT GAWLER
LOCALITY PLAN

4474



SCALE

200 0 200 400 600 800 1000

METRES

FIG. 2

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED A. Belperio	C.D.O. 21.12.87 DATE
DRAWN R. Bird	SCALE As shown
DATE Sept. 1987	PLAN NUMBER S19602
CHECKED	

PORT GAWLER 3 WELL COMPLETION REPORT

SEC. 687 HUNDRED OF PORT GAWLER

LOCATION OF DRILLHOLE

4474

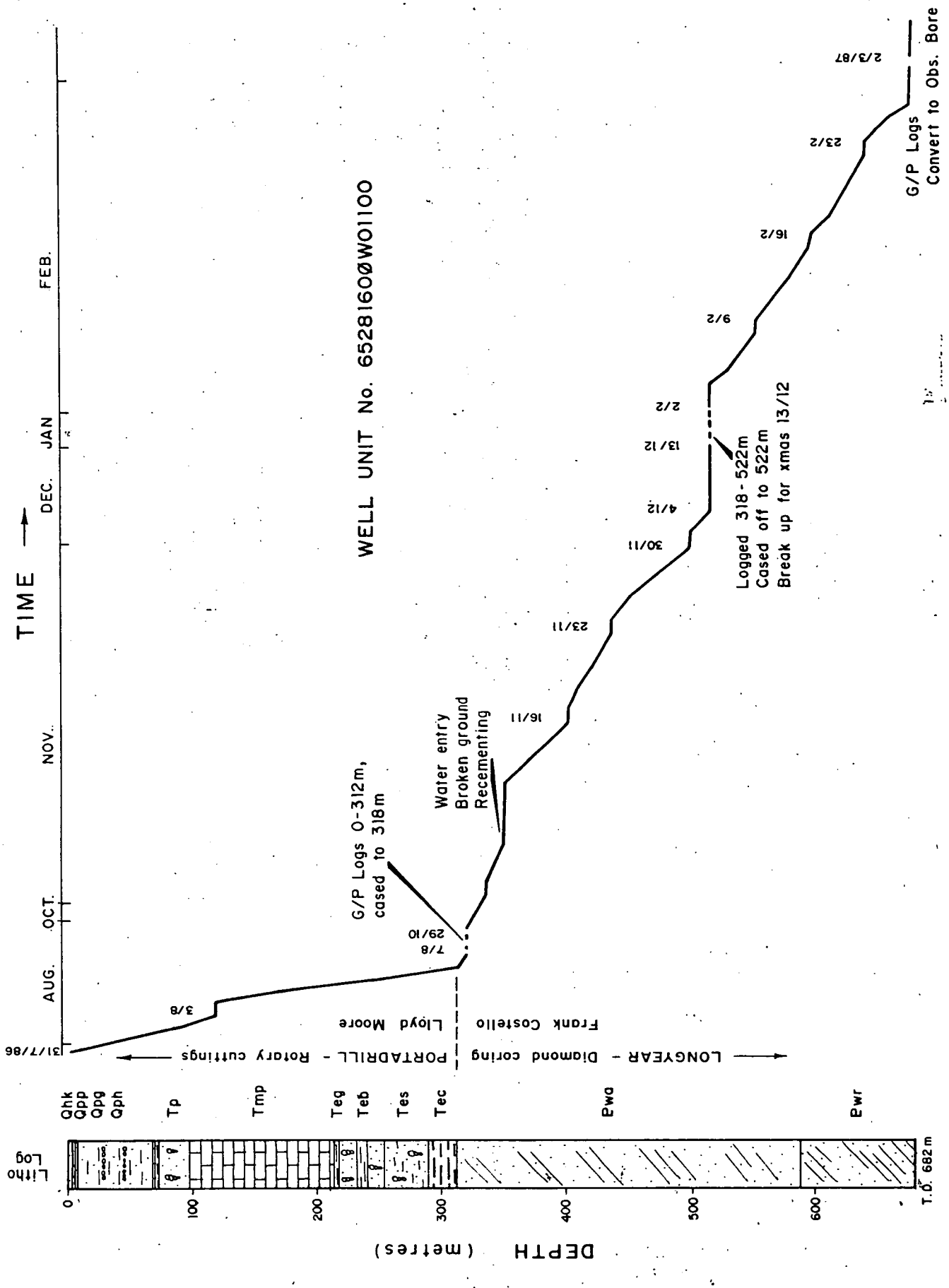


FIG. 3

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED: A. Belperio — CDO — 21·12·87 DATE
DRAWN: R. Bird — SCALE: As shown
DATE: Sept. 1987 — PLAN NUMBER: S19603
CHECKED

PORT GAWLER 3 WELL COMPLETION REPORT

SEC. 687 HUNDRED OF PORT GAWLER

DRILLING HISTORY

4474

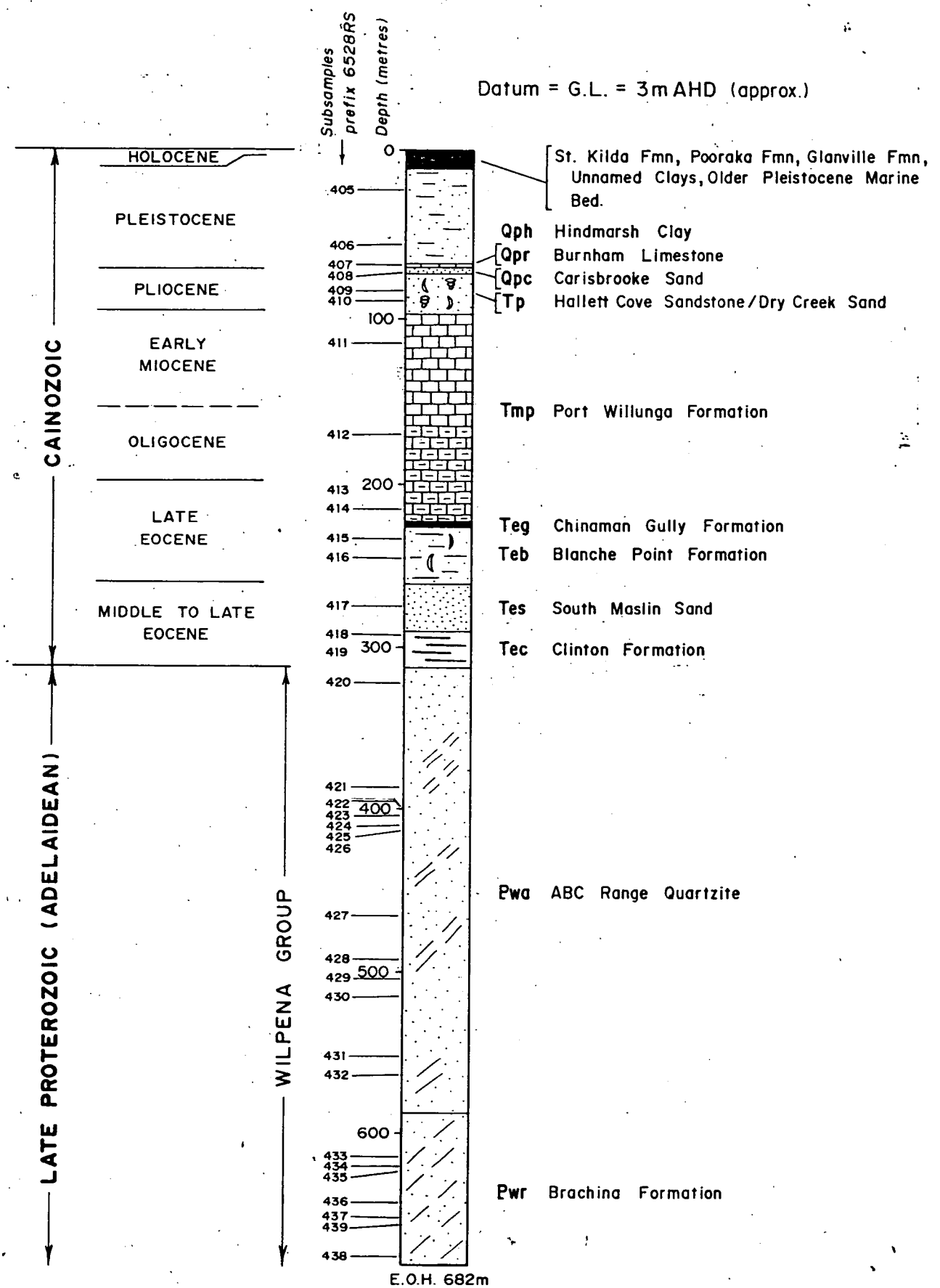


FIG. 4

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED A. Belperio — C.D.O — 21·12·87 DATE

DRAWN R. Bird — SCALE As shown

DATE Sept. 1987 — CHECKED

PLAN NUMBER S19604

PORT GAWLER 3 WELL COMPLETION REPORT
SEC. 687 HUNDRED OF PORT GAWLER

STRATIGRAPHIC SUMMARY

4474

COMPOSITE WELL LOG

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

PORT GAWLER 3
6528160ØW01100
(0-312 m)

STATE: SOUTH AUSTRALIA | 1:250000 MAP SHEET: ADELAIDE | 1:100000 MAP SHEET: VINCENT (6528)

BASIN: ST VINCENT | WELL STATUS: OBSERVATION WELL

LOCATION: Lat 34°39'14"S
Long 138°26'43"E
HUNDRED: PORT GAWLER
SECTION: 687

ELEVATION

DATE SPUDDED: 13/7/86
DATE DRILLING STOPPED: 25/2/87
DATE RIG RELEASED: 6/3/87
TOTAL DEPTH: 682 m

HOLE SIZE:

MILLIMETRES	FROM (m)	TO (m)
200	0	40
152	40	313·5
152	313·5	318
96	318	520·8
75	520·8	682

CASING:

MILLIMETRES	FROM (m)	TO (m)
152	0	39·2
100	0	318

SCREEN SET FROM TO

LOGGING

LOGS RUN	FROM (m)	TO (m)	DEPTH SCALE
GAMMA RAY	0	312	1:200
NEUTRON NEUTRON	0	312	1:200
GAMMA GAMMA (DENSITY)	0	312	1:200
SELF POTENTIAL	0	312	1:200
POINT RESISTANCE	0	312	1:200
16" NORMAL RESISTIVITY			
64" NORMAL RESISTIVITY			
6' LATERAL RESISTIVITY			
CALIPER	0	312	1:200
CALIPER			

MUD RESISTIVITY:

OTHER:

DRILLED BY: Dept. of Mines and Energy
DRILLING METHOD: ROTARY (0-318 m)
DIAMOND CORING (318-682 m)
LOGGED BY:
LOGGED BY: Dept. of Mines and Energy

LITHOLOGICAL REFERENCE

Granules, pebbles	Q Quartz	Ca Carbonate fragments
Sand, sandstone, quartzite	Py Pyrite	F Fossiliferous
Silt, siltstone	V Micaceous	f Feldspathic
Clay, mudstone	C Carbonaceous	Gy Gypsiferous
Limestone	Fe Ferruginous	Mn Manganese
Interlaminated sandstone and mudstone	Glauconitic	Hum Humic
Interlaminated siltstone and sandstone	Si Siliceous	Lig Lignitic
Mud drapes, mud lumps	Calcareous	Burrow
Lateral accretion coset	P Mud pellets	Convolute bedding
Tabular crossbedding	Graded bedding	Flaser bedding
Trough crossbedding	Starved ripples	Syneris cracks
HCS Hummocky cross stratification coset	Mud cracks	ox Red bed
6528RS405 Rock sample for analysis	Facing	xxx Fracture zone

LITHOLOGICAL DESCRIPTION

0-2·5 m
Unconsolidated skeletal sand, pale yellowish orange, abundant mollusca foraminifera and coralline alga

2·5-5·0 m
Sandy clay, micaceous, moderate yellowish brown

5·0-6·5 m
Cemented skeletal limestone, vadose micritic calcrete

6·5-10·0 m
Poorly sorted sandy clay, yellowish brown and reddish brown

10·0-12·0 m
Mixed skeletal and quartz sandstone, well cemented, pale orange to yellowish orange

12·0-67·5 m
Poorly sorted, micaceous sandy clay and sandy silty clay with interbeds of coarse angular sand and gravel. Mottled reddish brown and yellow brown. Red-brown earth profile development with patches of pedogenic carbonate silt. Gleyed soil profile from 54-60 m

67·5-69·5 m
Fossiliferous, calcareous sandstone, micritic cement. Very pale orange with well rounded quartz grains

69·5-73·0 m
Weakly calcareous, poorly sorted sandy clay and clayey quartz sand. Greyish red and light olive grey

73·0-73·5 m
Fossiliferous, calcareous sandstone, white and yellowish orange, well cemented with micrite

73·5-97·0 m
Pale yellowish brown, grading to very light grey silty, shelly sand medium to coarse grained. Abundant mollusc, bryozoa and foraminifera. Minor organic fragments. Interbeds of cemented calcareous sandstone and mottled, pale brown mudstone. Abundant glauconite, ferruginised quartz grains and fibrous organic detritus at 87·0 m. Increasing mud content with depth to a yellowish brown, sandy, shelly marl. Increasing bryozoan component towards the base.

97·0-167·0 m
White to light grey, coarse grained, very poorly sorted bryozoal limestone and bryozoal and foraminiferal calcarenite. Minor red brown and mottled, non-calcareous sandy mudstone.

Increasing glauconite with depth as discrete pellets, as composite faecal pellets, as replacement of matrix, as replacement of skeletal fragments, and as matrix infilling of lithoskels. Increasing echinoid detritus with depth. Most large quartz grains are well rounded and stained with a haematitic coating. Interbeds of dark grey, fine grained, saccharoidal sandstone are common towards the base.

167·0-197·0 m
Glauconitic, muddy, skeletal calcarenite. Medium grey, poorly sorted, with alternating weakly consolidated and silicified beds. Primarily foraminiferal, bryozoal, echinoid and mollusca biota. Well rounded, ferruginised quartz grains. Minor interbeds of light grey sandy marl

197·0-214 m
Dark grey, weakly calcareous, bioturbated micaceous sandy mudstone. Poorly sorted with discrete, rounded glauconite grains and pellets. Fossiliferous and carbonaceous. Minor muddy calcarenite and glauconitic, skeletal limestone. Increasingly pyritic and organic towards the base

214·0-222·0 m
Dark grey, weakly calcareous micaceous mudstone, often burrowed and bioturbation. Burrows infilled with fine glauconitic sand. Subordinate shelly calcarenite and glauconitic skeletal limestone with remnant organic sheaths. Increasing pyrite, glauconite and dispersed organic matter towards the base

222·0-226·0 m
Black, non-calcareous, micaceous and pyritic mudstone with abundant finely dispersed organic matter. Some burrowing and bioturbation and glauconite.

226·0-254·0 m
Light grey, glauconitic muddy skeletal limestone and bioturbated, grey, micaceous mudstone. Interbeds of silicified, glauconitic sandstone towards the base. Increasing glauconite from 244-254 m.

254·0-261·0 m
Dark grey, well cemented, poorly sorted, fine to medium grained, silicified glauconitic sandstone. Well rounded glauconite pellets and well rounded, saccharoidal quartz grains. Associated glauconitic skeletal limestone.

261·0-290·0 m
Olive-black, unconsolidated, very poorly sorted, carbonaceous fine silty sand and muddy sand. Abundant framboidal and disseminated pyrite, pyritised infilled burrows, and dispersed fine organic detritus. Minor glauconite, and bryozoa and echinoid fragments. Interbeds of muddy skeletal limestone, black, pyritic and micaceous mudstone, and fine saccharoidal sandstone. Increasing organic and mud content, and decreasing microfauna, with depth.

290·0-312·2 m
Black, micaceous and pyritic, fine lignitic mudstone. Abundant pyrite framboids, minor glauconite pellets, and leaf impressions common. Interbedded organic, sandy mud with a sparce foraminiferal fauna, and pockets of skeletal-rich sand. Minor interbeds of shelly marl, and glauconitic calcarenite.

312·2-318·0 m
White to light grey, quartz sandstone. Crossbedded, with graded interbeds from coarse and gritty to fine grained and well sorted. Small mud lump impressions and cavities after ?pyrite. Dip approximately 25°, facing up

FIG. 5

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	
PORT GAWLER 3 WELL COMPLETION REPORT	COMPILED A. Belperio
SEC. 687 HUNDRED OF PORT GAWLER	DRAWN R. Bird
WELL 6528160ØW01100	DATE Sept. 1987
(0-312 metres)	CHECKED
COMPOSITE WELL LOG	C.D.O. DATE 21-12-87
	SCALE As shown
	PLAN NUMBER 87-784

COMPOSITE WELL LOG

DEPARTMENT OF MINES AND ENERGY — SOUTH AUSTRALIA

PORT GAWLER 3

6528160ØW01100

(312 - 682m)

STATE: SOUTH AUSTRALIA | 1:250000 MAP SHEET: ADELAIDE | 1:100000 MAP SHEET: VINCENT (6528)

BASIN: ST VINCENT | WELL STATUS: OBSERVATION WELL

LOCATION: Lat. 34°39'14" S
Long. 138°26'43" E
HUNDRED: PORT GAWLER
SECTION: 687

ELEVATION:

DATE SPUDDED: 13/7/86
DATE DRILLING STOPPED: 25/2/87
DATE RIG RELEASED: 6/3/87
TOTAL DEPTH: 682

HOLE SIZE:

MILLIMETRES	FROM (m)	TO (m)
200	0	40
152	40	313·5
152	313·5	318
96	318	520·8
75	520·8	682

CASING:

MILLIMETRES	FROM (m)	TO (m)
152	0	39·2
100	0	318

SCREEN SET: FROM TO

LOGGING

LOGS RUN	FROM (m)	TO (m)	DEPTH SCALE
GAMMA RAY	318	680	1:200
NEUTRON NEUTRON	318	680	1:200
GAMMA GAMMA (DENSITY)	318	680	1:200
SELF POTENTIAL	318	680	1:200
POINT RESISTANCE	318	680	1:200
16" NORMAL RESISTIVITY			
64" NORMAL RESISTIVITY			
6' LATERAL RESISTIVITY			
CALIPER	318	680	1:200
HOLE DEVIATION	530	680	1:200

MUD RESISTIVITY:

OTHER:

DRILLED BY: Dept. of Mines and Energy
DRILLING METHOD: ROTARY (0 - 318m)
DIAMOND CORING (318 - 682m)
LOGGED BY: Dept. of Mines and Energy

LITHOLOGICAL REFERENCE

	Granules, pebbles	Q	Quartz	Co	Carbonate fragments
	Sand, sandstone, quartzite	Py	Pyrite	F	Fossiliferous
	Silt, siltstone	V	Micaceous	f	Feldspathic
	Clay, mudstone	C	Carbonaceous	Gy	Gypsiferous
	Limestone	Fe	Ferruginous	Mn	Manganese
	Interlaminated sandstone and mudstone		Glauconitic	Hum	Humic
	Interlaminated siltstone and sandstone	Si	Siliceous	Lig	Lignitic
	Mud drapes, mud lumps		Calcareous		Burrow
	Lateral accretion coset	P	Mud pellets		Convolute bedding
	Tabular crossbedding		Graded bedding		Flaser bedding
	Trough crossbedding		Starved ripples		Syneris cracks
HCS	Hummocky cross stratification coset		Mud cracks	ox	Red bed
6528RS405	Rock sample for analysis		Facing	xxx	Fracture zone

LITHOLOGICAL DESCRIPTION

312·2 - 357·8m
White to light grey, non calcareous, fine grained quartz sandstone and quartzite. Grains moderately rounded and well sorted. Minor feldspar, heavy minerals and opaques. Graded in places to a coarse gritty sandstone. Decimetre thick interbeds of poorly sorted, muddy sandstone. Millimetre thick mud drapes and rare thicker mud layers and mud lumps. Disseminated pyrite spheroids associated with mud drapes. Lateral accretion cosets up to 50cm in height. Synerosis cracks are common in flaser bedded mud/sand laminae, some possible burrows and mudcracks. Facing up, dip 35°→west. Joints dip 75°→east and highlighted by chlorite and pyrite

357·8 - 421·8m
Grey, fine grained, dense quartzite with mud drapes, mud clasts and thin mud laminae, crossbed cosets to 30cm and decimetre thick, plane coarsening upward beds. Increased proportion of thicker, grey-black, silty mudstone and flaser bedded mud/sand laminae. Some mudstone interbeds oxidised to a red-brown colour. Abundant lateral accretion cosets and some bidirectional tabular crossbed cosets.

421·8 - 456·3m
Predominantly light grey, dense quartzite with remnant medium grained, well rounded quartz gains. Thin mud drapes, mud laminae and mud lumps. Granular and less silicified where more poorly sorted. Decimetre scale lateral accretion cosets. Zones of soft sediment deformation and convoluted bedding. Rare, oxidised, red micaceous mudstone interbeds up to 10cm thick

456·3 - 501·8m
Interbedded and interlaminated, grey, medium grained, poorly sorted feldspathic sandstone and grey-green micaceous mudstone. Mudstone beds locally oxidised to red-brown. Abundant mud pellets, mud lumps and mud drapes and mud flasers in the sandstone. Some trough crossbedding and lateral accretion cosets. Individual mudstone beds with starved ripples are up to 50cm thick, but also form centimetre and millimetre scale sand-mud couplets containing abundant water escape structures, synerisis cracks. Synsedimentory pyrite is associated with the fine mud flasers, and also occurs as millimetre diameter spheroids (pyritised mud pellets) in the sandstones. Secondary sulphide occurs in minor joints and fractures. Strata dip 30°→west; Joints strike 200°, dip vertical

501·8 - 504·7m
Grey-green, fine, micaceous, sandy mudstone. Thin laminae and starved ripples of medium grained, poorly sorted feldspathic sand. Finely disseminated sulphide

504·7 - 557·7m
Grey, poorly sorted, medium grained, bimodal, muddy feldspathic sandstone. Well rounded quartz grains and secondary chlorite and amphibole. Trough crossbeds. Abundant thin mudstone laminae, mud drapes and mud lumps. Rare thicker mudstone beds to 60cm

(Dolomite - host brecciation)

(2cm thick, cream calcilutite bed with large well rounded quartz grains)

557·7 - 587m
Interbedded quartzite, muddy sandstone and mudstone. Quartzites are generally, grey and fine grained, grading to coarser, less cemented muddy and feldspathic sandstones with abundant mud drapes, mud laminae and mud lumps. Some quartzites show distinct fining upward sequences. Mudstones are grey-black or variably oxidised to red-brown, micaceous and chloritic, and contain starved ripples, thin sand beds and water escape structures.

1m thick sequence of sandstone beds showing stacked lateral accretion cosets with steep forcast bedding, double mud drapes and shale clasts.

587 - 682·2m
Interbedded, grey-black, sandy, muddy siltstone, silty mudstone and poorly sorted, gritty and pelletal sandstone with abundant thin silstone laminae. Oxidised mudstone beds and gritty sandstone beds are common. Fining upward, gritty sandstone cycles may represent hummocky cross-stratification on a metre scale. Strata dip 30°→275°

FIG. 6

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

PORT GAWLER 3 WELL COMPLETION REPORT

SEC. 687 HUNDRED OF PORT GAWLER

WELL 6528160ØW01100

(312 - 682 metres)

COMPOSITE WELL LOG

COMPILED	A. Belperio
DRAWN	R. Bird
DATE	Sept 1987
CHECKED	
C.D.O. / DATE	21 12 87
SCALE	As shown
PLAN NUMBER	87-785

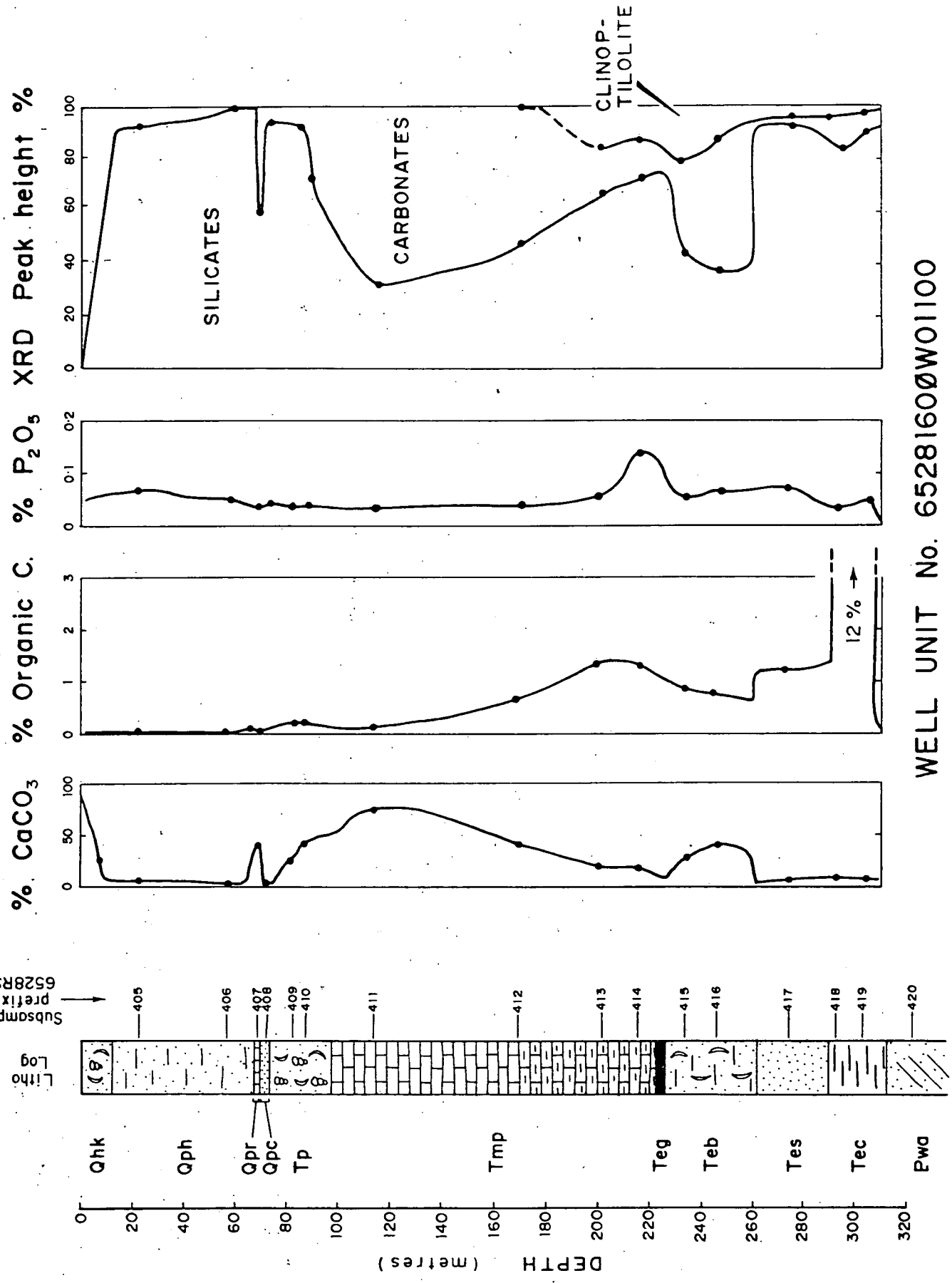


FIG. 7

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED A. Belperio	C.D.O. DATE
PORT GAWLER 3 WELL COMPLETION REPORT SEC. 687 HUNDRED OF PORT GAWLER DOWN-CORE CHEMISTRY AND MINERALOGY RESULTS (CAINOZOIC)	DRAWN R. Bird	SCALE As shown
	DATE Sept. 1987	PLAN NUMBER S19605
	CHECKED	

4474

SHELLGRIT

ROAD

Buckland Park 1
6528-533
(280)

ROAD

GAWLER

PORT

Port Gawler 3
6528-1100
(312)

ICI
6528-675
(316)

Port Gawler F
6528-243
(350)

Buckland Park 2
6528-550
(322)

Legoe 1
6528-535
(314)

SV-78-H
SV-78-G2
SV-78-K
SV-78-J
SV-78-G1
SV-80-A
SV-78-1
SV-80-B
SV-79-A

BUCKLAND FAULT

Gawler River

L E G E N D

Well: Legoe 1 — Name
6528-535 — Unit No. (abbrev.)
(314) — Depth to Bedrock (m)

SV-80-B — Seismic Line and number

Bedrock fault showing downthrow

Cainozoic sediments isopach (m) (Interpreted from seismic sections and boreholes)

20 — Interpreted dip and strike

Bedrock Geology

- Cambrian Dolomites
- Unconformity
- ABC Range Quartzite
- Brachina Formation

500 0 500 1000
metres

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

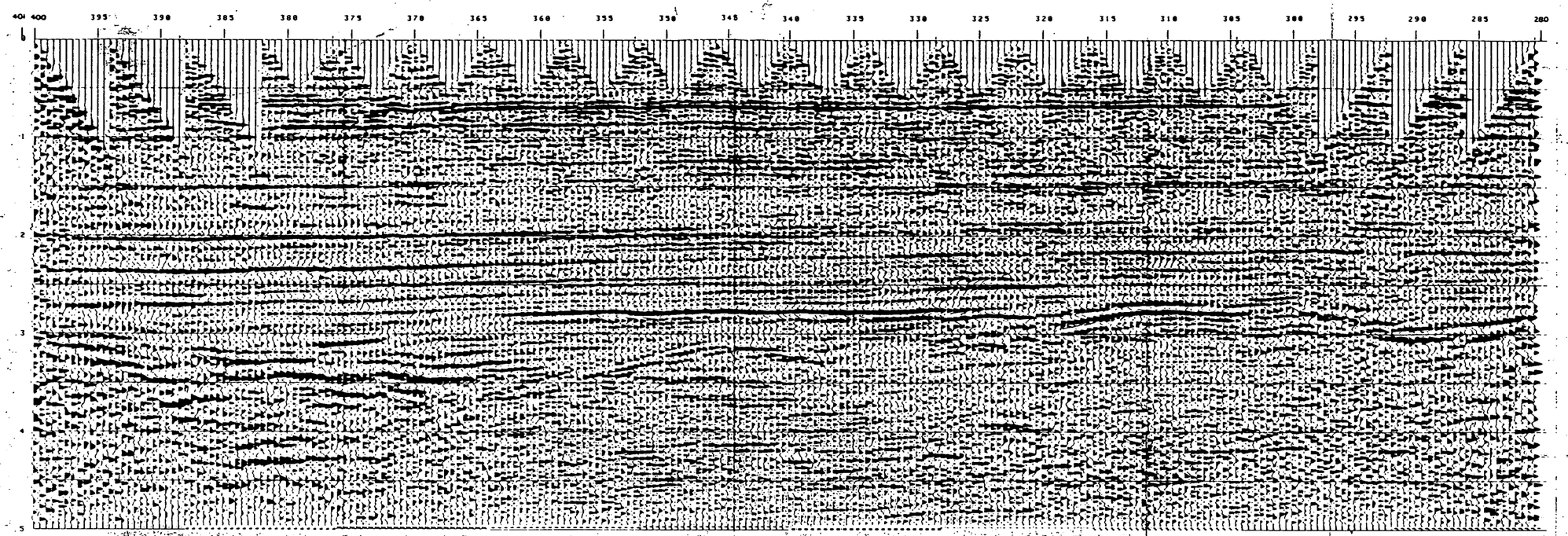
PORT GAWLER 3 WELL COMPLETION REPORT
SEC. 687 HUNDRED OF PORT GAWLER

INTERPRETED BEDROCK GEOLOGY

A.B.
R.B.
Sept 1987
1: 20000

87-786

FIG. 8



DEPARTMENT OF MINES AND ENERGY
(SOUTH AUSTRALIA)
AREA : PORT GAWLER
LINE : SV-78-GI
STATIONS : 401-280
DIGISTACK

FIELD DATA

CREW : S A DEPARTMENT OF MINES, GEO SURVEY — DATE : 6TH SEPTEMBER 1978
RECORDING INST : DHR-1632 — FORMAT : SEG F
RECORDING FILTER : 120-300 Hz
SPREAD CONFIGURATION : 0-10-470 m
GAIN INFORMATION : BINARY
RECORDING LENGTH : 1.0 sec — SAMPLE RATE : 0.5 ms
GROUP INTERVAL : 20 — SP INTERVAL : 120 m
NO OF GROUP : 24
CHARGE : ANZ
DATUM : 10 m BELOW AUSTRALIA HEIGHT DATUM

DATA PROCESSING SEQUENCE

1. DEMULTIPLEX
2. RESAMPLE : 2 ms
3. EDIT AND STATICS SHIFT : 11 ms
4. DATUM STATICS
5. COMMON DEPTH POINT GATHER
6. DECONVOLUTION (GAP)
   - NO OF FILTER : 1 — WHITE NOISE : 0.1 % — FILTER LENGTH : 60 m — GAP : 4 ms
   - DESIGN GATES NEAR OFFSET : 100 ms — 725 ms
   - DESIGN GATES FAR OFFSET : 325 ms — 825 ms
7. INITIAL NORMAL MOVEOUT
8. INITIAL : 4 FOLD STACK
9. VELOCITY ANALYSIS BEFORE AUTOSTATICS
10. RESIDUAL STATICS @ 4 FOLD STACK
11. VELOCITY ANALYSIS AFTER AUTOSTATICS
12. FINAL NORMAL MOVEOUT
13. FINAL COMMON DEPTH POINT SUM : 4 FOLD DIGISTACK
14. DIGITAL FILTER — NO OF FILTER : 1

TIME (sec)	BAND PASS (Hz)	TIME (sec)	BAND PASS (Hz)
0.0 - 0.5	40 - 250		

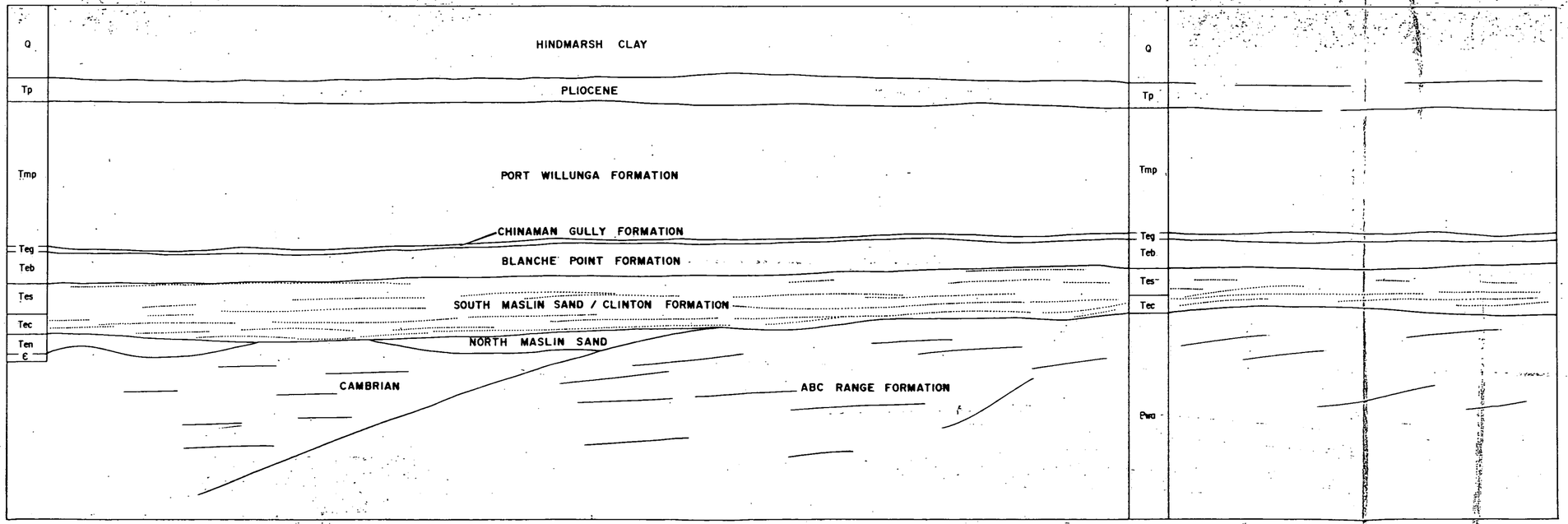
15. TIME VARYING EQUALIZATION — GATE LENGTH : 150 ms
16. MIGRATION — DATE : 31ST JULY 1979

PROCESSED BY
digicon b.v.
SINGAPORE

QUALITY CONTROL CHECK
DISPLAY AND DRAFTING : brenda
SEISMIC
PARTY CHIEF
SUPERVISOR

PORT GAWLER F

PORT GAWLER 3
(projected)



Carbonaceous horizons

Inferred bedding trends

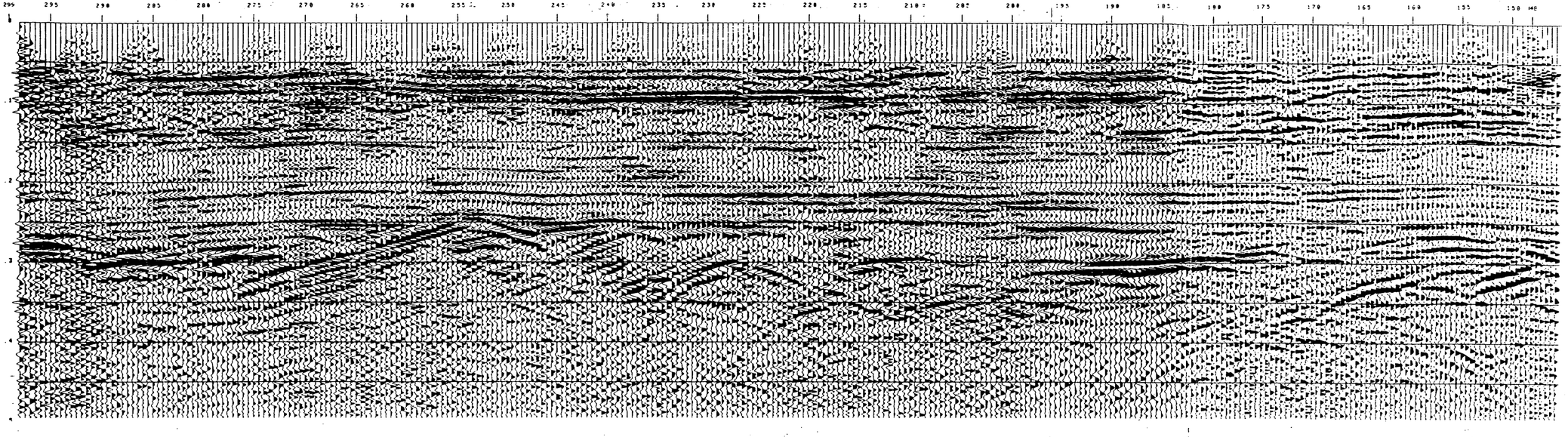
FIG. 9

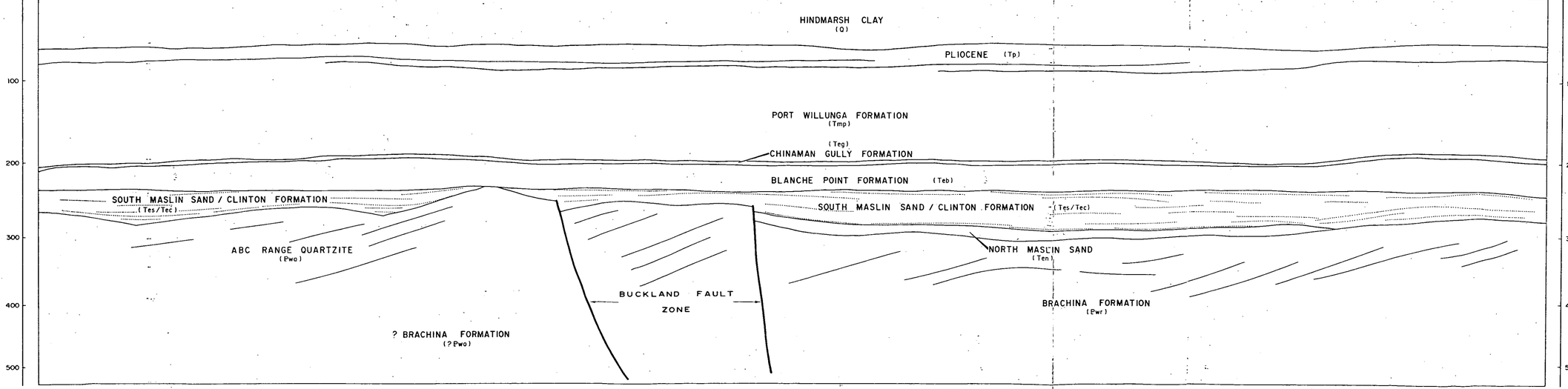
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

PORT GAWLER 3 WELL COMPLETION REPORT
SEC. 687 HUNDRED OF PORT GAWLER

SEISMIC SECTION SV-78-GI
AND INTERPRETATION

COMPILED : A. Delgado
DRAWN : R. Silva
DATE : Sept. 1987
CHECKED
DATE
SCALE : As shown
PLAN NUMBER
87-787





Carbonaceous horizons

Inferred bedding trends

DEPARTMENT OF MINES AND ENERGY
(SOUTH AUSTRALIA)
AREA : PORT GAWLER
LINE : SV-78-G2
STATIONS : 299 - 148
DIGISTACK

FIELD DATA

CREW : S.A. DEPARTMENT OF MINES, GEO SURVEY — DATE : 13TH SEPTEMBER 1978
RECORDING INST : DHR - 1632 — FORMAT : SEG "
RECORDING FILTER : 120-500 Hz
SPREAD CONFIGURATION : 110-10-0-10-350m , 230-10-0-10-350m , 300-10-0-10-110m
GAIN INFORMATION : BINARY
RECORDING LENGTH : 1.0 sec — SAMPLE RATE : 0.5 ms
GROUP INTERVAL : 20 m — SP INTERVAL : 120 m
NO OF GROUP : 24
CHARGE : AN2
DATUM : 10m BELOW AUSTRALIA HEIGHT DATUM

DATA PROCESSING SEQUENCE

- [X] DEMULTIPLEX
- [X] RESAMPLE : 2 ms
- [X] EDIT AND STATICS SHIFT : 11 ms
- [X] DATUM STATICS
- [X] COMMON DEPTH POINT GATHER
- [X] DECONVOLUTION
  - NO OF FILTER : 1 — WHITE NOISE 0.1 % — FILTER LENGTH 80 ms — GAP 4 ms
  - DESIGN GATES NEAR OFFSET 100 ms - 725 ms
  - DESIGN GATES FAR OFFSET 325 ms - 825 ms
- [X] INITIAL NORMAL MOVEOUT
- [X] INITIAL 6 FOLD STACK
- [X] VELOCITY ANALYSIS BEFORE AUTOSTATICS
- [X] RESIDUAL STATICS 8_6 FOLD STACK
- [X] VELOCITY ANALYSIS AFTER AUTOSTATICS
- [X] FINAL NORMAL MOVEOUT
- [X] FINAL COMMON DEPTH POINT SUM 6 FOLD DIGISTACK
- [X] DIGITAL FILTER — NO OF FILTER 1

TIME (sec)	BAND PASS (Hz)	TIME (sec)	BAND PASS (Hz)
0-0.5	40-300		

- [X] TIME VARYING EQUALIZATION — GATE LENGTH 250 ms
- [ ] MIGRATION

DATE 28TH JUNE 1979

PROCESSED BY
digicon b.v.
SINGAPORE

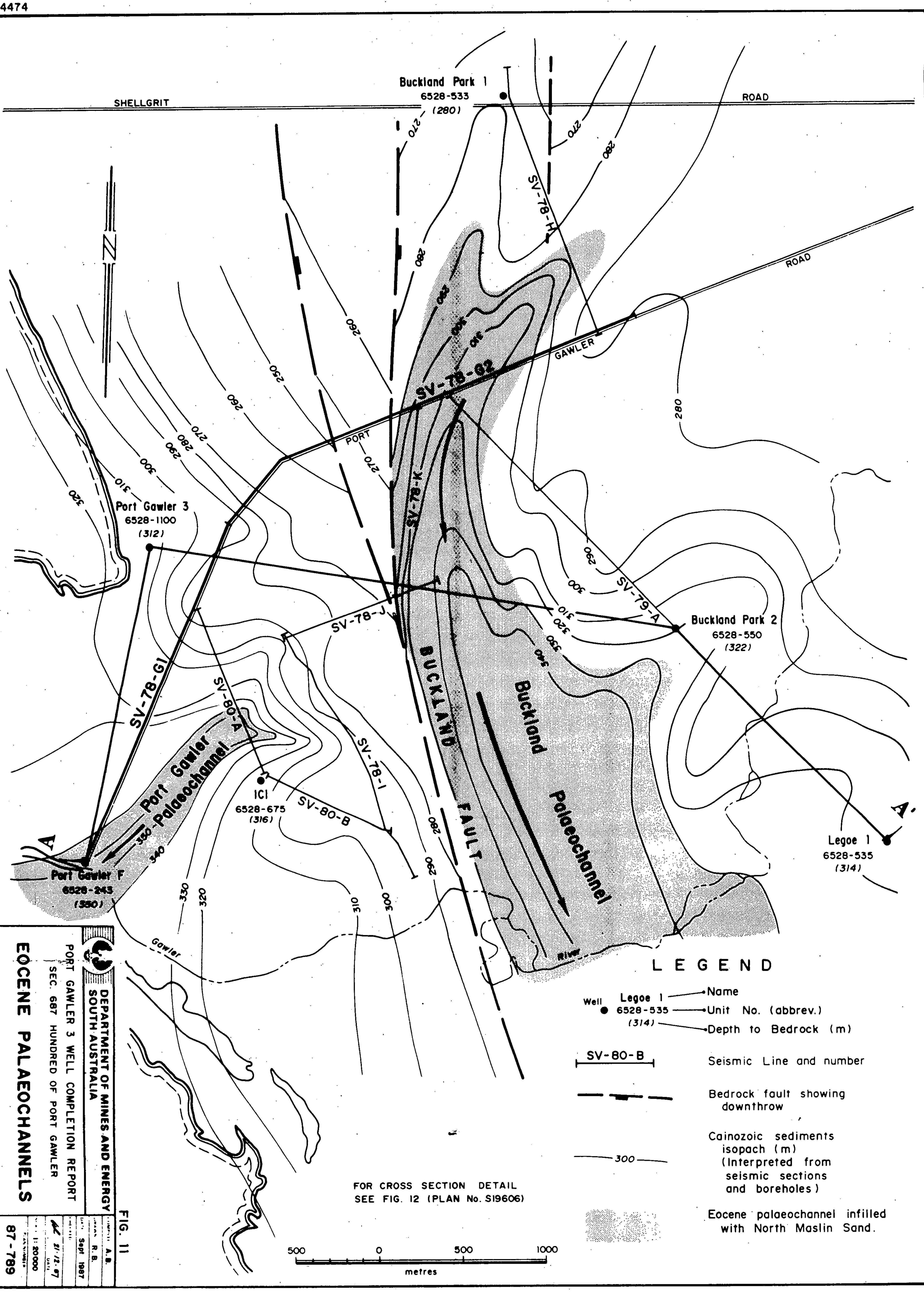
QUALITY CONTROL CHECK
DISPLAY AND DRAFTING Brooks
SEISMIC
PARTY CHIEF
SUPERVISOR

FIG. 10.

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

PORT GAWLER 3 WELL COMPLETION REPORT
SEC. 687 HUNDRED OF PORT GAWLER
SEISMIC SECTION SV-78-G2
AND INTERPRETATION

COMPILED	A.T.Belperio
DRAWN	R. Bird
DATE	Sept. 1987
CHECKED	
SCALE	As shown
PLAN NUMBER	87-788

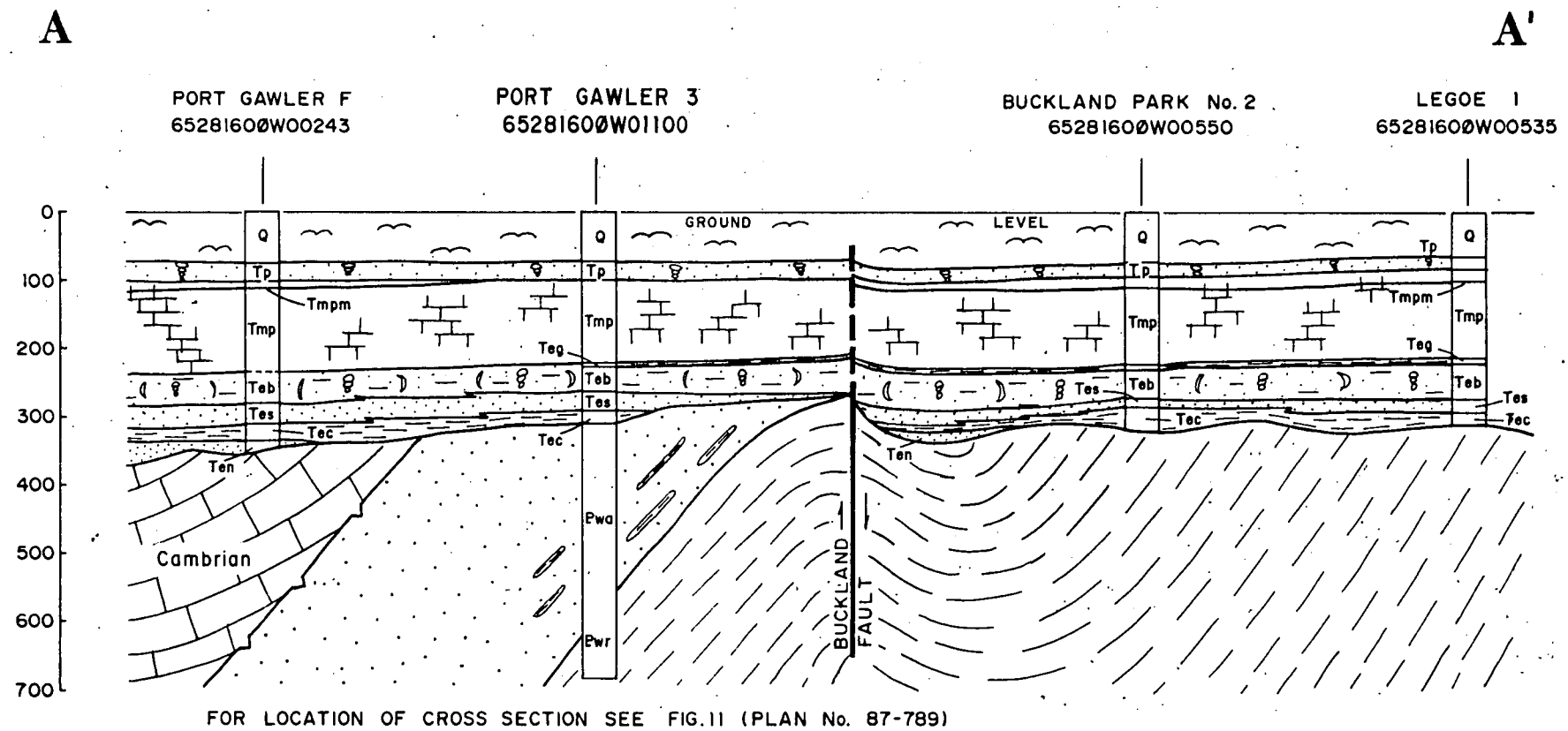

Buckland Park 1
6528-533
(280)
SHELLGRIT ROAD
PORT GAWLER ROAD
SV-78-H
SV-78-G2
SV-78-K
SV-78-J
SV-78-G1
SV-80-A
SV-78-I
SV-80-B
SV-79-A
BUCKLAND FAULT
Buckland Palaeochannel
Port Gawler Palaeochannel
Port Gawler 3
6528-1100
(312)
Buckland Park 2
6528-550
(322)
ICI
6528-675
(316)
Port Gawler F
6528-243
(350)
Legoe 1
6528-535
(314)
A
A'
Gawler River
LEGEND
Well
Legoe 1 — Name
6528-535 — Unit No. (abbrev.)
(314) — Depth to Bedrock (m)
SV-80-B — Seismic Line and number
Bedrock fault showing downthrow
300 — Cainozoic sediments isopach (m) (Interpreted from seismic sections and boreholes)
Eocene palaeochannel infilled with North Maslin Sand.
FOR CROSS SECTION DETAIL
SEE FIG. 12 (PLAN No. S19606)
500 0 500 1000
metres
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA
PORT GAWLER 3 WELL COMPLETION REPORT
SEC. 687 HUNDRED OF PORT GAWLER
EOCENE PALAEOCHANNELS
FIG. 11
A.B.
R.B.
Sept 1987
21.12.87
1:20000
87-789

CROSS SECTION A - A'

PORT GAWLER 3 WELL COMPLETION REPORT
SEC. 687 HUNDRED OF PORT GAWLER

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED A. Belperio
DRAWN R. Bird
DATE Sept. 1987
CHECKED
DATE 21.10.87
C.D.O
SCALE As shown
PLAN NUMBER S19606



FOR LOCATION OF CROSS SECTION SEE FIG.11 (PLAN No. 87-789)

FIG. 12