Institute of Geological Sciences
Marine Geology Unit
Report No 83/8

# WHITETHORN CRUISE 83/8

Leg 2

27th April - 11th May 1983

by

N.G.T. FANNIN

May 1983

## INTRODUCTION

This cruise was planned primarily to use the new IGS 6 m rock drill to identify rock outcrops in areas where solid rock was covered by a few metres of unconsolidated sediment in the Fair Isle Sheet (Fig 1). A number of geological boundaries in the Fair Isle area are difficult to define on geophysics alone and so it was particularly important to recover sufficient identifiable material so that accurate contacts could be mapped. In addition gravity core and sediment samples were required to provide sediment data for the Quaternary and sea bed sediment maps. During the cruise a number of additional grab samples were collected for a special study of the living fauna by biologists at the Royal Scottish Museum.

In weather down time cores from the previous cruises in the Malin and Foula area were cut and logged and in poor weather a number of gravity core and grab samples were collected to the west of Orkney.

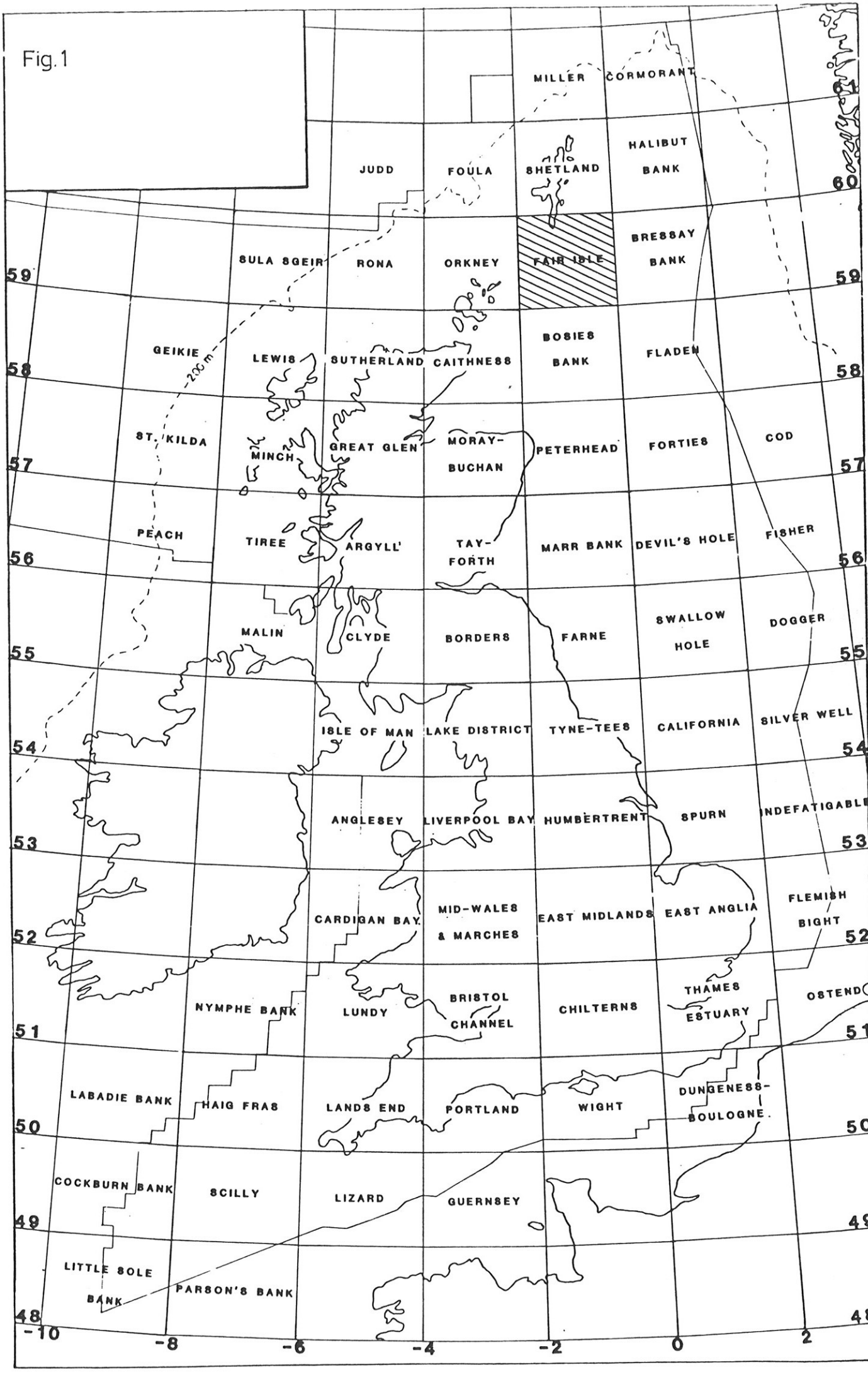
## CRUISE SUMMARY

The cruise was spent working in the Fair Isle Sheet area with some samples being collected from west of the Orkney Islands. Weather conditions were reasonable during most of the cruise with 59 hours lost due to weather downtime. A total of 142 stations were occupied ining 29 rock drill sites, 82 gravity core and grab sample sites and 31 grab sample only sites. The rock drill was very successful but gravity coring was considerably less so largely because of the sand cover which prevented corer penetration. Biological samples were collected at 34 stations. A summary cruise log is given in Appendix I, time utilisation data in Appendix II, 6 m rock drill statistics in Appendix III and drill site logs in Appendix IV.

## PERSONNEL

| | | |
|---|---|---|
| N G T Fannin | Senior Geologist | IGS (MGLU) |
| D Evans | Day Geologist | IGS (MGLU) |
| M Stoker | Night Geologist | IGS (MGLU) |
| J Pheasant | Engineer | IGS (MGLU) |

Fig.1


MILLER
CORMORANT
JUDD
FOULA
SHETLAND
HALIBUT BANK
SULA SGEIR
RONA
ORKNEY
FAIR ISLE
BRESSAY BANK
GEIKIE
200m
LEWIS
SUTHERLAND
CAITHNESS
BOSIES BANK
FLADEN
ST. KILDA
MINCH
GREAT GLEN
MORAY-BUCHAN
PETERHEAD
FORTIES
COD
PEACH
TIREE
ARGYLL'
TAY-FORTH
MARR BANK
DEVIL'S HOLE
FISHER
MALIN
CLYDE
BORDERS
FARNE
SWALLOW HOLE
DOGGER
ISLE OF MAN
LAKE DISTRICT
TYNE-TEES
CALIFORNIA
SILVER WELL
ANGLESEY
LIVERPOOL BAY
HUMBERTRENT
SPURN
INDEFATIGABLE
CARDIGAN BAY
MID-WALES & MARCHES
EAST MIDLANDS
EAST ANGLIA
FLEMISH BIGHT
NYMPHE BANK
LUNDY
BRISTOL CHANNEL
CHILTERNS
THAMES ESTUARY
OSTEND
LABADIE BANK
HAIG FRAS
LANDS END
PORTLAND
WIGHT
DUNGENESS-BOULOGNE
COCKBURN BANK
SCILLY
LIZARD
GUERNSEY
LITTLE SOLE BANK
PARSON'S BANK
61
60
59
58
57
56
55
54
53
52
51
50
49
48
-10
-8
-6
-4
-2
0
2

| | | |
|---|---|---|
| N Ruckley | Surveyor | IGS (MGLU) |
| G Tulloch | Night Laboratory | IGS (MGLU) |
| P Wiggins | Technician | IGS (MGLU) |
| A Bell | Deck Operations | IGS (MGLU) |
| Miss L Jobson | Geologist/geochemist | IGS (MGLU) |
| Miss S Chambers | Biologist | Royal Scottish Museum |

GEOLOGICAL SUMMARY

The principal problem in the Fair Isle area has been the definition of the Old Red Sandstone (ORS) and Permo-Triassic boundaries and the recognition of possible Lower Cretaceous rocks in the southern part of the area.

The recognition of facies changes within both the ORS and the Permo-Triassic is also important.

As a result of the drilling extensive areas of Middle ORS flagstone facies sediments can now confidently be mapped as can a large area of Permo-Triassic very coarse, friable, pebbly sandstones, often mottled and interbedded greenish white in colour, in a predominantly purplish red succession. At a number of sites however hard cross laminated fine red sandstones of uncertain age were cored and further work is required to define the boundary in these areas though some samples of very hard dark red fine sandstones are probably ORS in age. Convincing Cretaceous rocks have not yet been recovered (except perhaps site 59-01/219 DR) and one curious sample (59-02/251 DR) of brecciated, partly silicified sandstone is of unknown age.

Recovery of unconsolidated material by the rock drill is poor with most of the loose sediment removed by the water flush.

Some stiffer material may be recovered and these samples, with the gravity cores, suggest that reddish pebbly clayey sands and sandy clays are the most common pre Holocene sediments (mainly tills with some glacio-marine sediments) In one sample (59-02/296 DR) however, a stiff unconsolidated highly fissured grey clay was recovered and this may well be

pre-Weichselian in age.

The sea bed sediments vary considerably in character with dominantly terrigenous fine - very fine sands in deeper water (>120 m). The sediment becomes coarser and the shell content increases dramatically as the water depth decreases and in depths less than 100 m the sediment is a coarse to very coarse shell sand. In some samples the shell content is 100%. Biologically the coarse shelly sands have a sparse living fauna with the richest and most diverse fauna in finer sediments in the deeper water.

## Six Metre Rock Drill

The 6 m rock drill has been recently developed by the Marine Geology Unit of IGS and this was its first routinely operational cruise. The drill was operated for a total of 21.4 hours occupying 29 stations where it was deployed 42 times, successfully recovering rock core on 23 occasions. The drilling statistics are given in Appendix III and drill site logs in Appendix IV.

Technically the drill was remarkably successful with only 1 hours down-time during the cruise and is now regarded as a fully operational item of equipment.

The drill, which utilises the successful IGS 6 m vibrocorer frame, is intended principally for rotary coring operations using diamond or tungsten carbide bits. It also however can be operated in the vibrating mode and penetration can be aided by a water flushing system in either mode. Drill condition is monitored visually by TV and electronically with a VDU display giving a 3 second up-date and a printer giving hard copy at 1 minute intervals. The drill can be operated on exposed bed rock or rock with a sediment cover. The effective reach of the drill is 5.5 m below sea bed and the core diameter is 47 mm.

Further experience will improve the operational efficiency of the drill and future developments should look towards improved water flush control and bit design particularly with the development of bits with internal fluid pathways. The principal reasons for failure (on 13 attempts)

to recover rock core was lack of penetration because either the bit was blocked by a cobble or the water flush was unable to clear the cutting surfaces again allowing the bit to block off. On 5 occasions rock head was found to be greater the 5.5 m below seabed and the target was not reached.

Drill deployment time ranged between 35 and 140 minutes (average 56.5 min) and actual drilling time varied from 6 - 80 minutes (average 22min). In hard sandstone penetration rates of approximately 2 cm per minute were achieved while in soft friable sandstones rates of 10 - 15 cm per minute were common. A total of approximately 27.2 m of solid rock were drilled and 15.74 m (58%) of solid core was recovered. Core recovery considerably reflected rock type with recovery rates of the order of only 44 % in deeply weathered or soft friable rocks but with rates of 90 - 100% in well indurated rocks. The fracture/jointing condition of the rock was also significant with limited recovery in badly fractured rocks with, in some instances, blocking of the bit by rotated core fragments.

Equipment Operation

The 6 m rock drill performance has been discussed already. The gravity corer functioned without any problem and one shipek grab was slightly damaged and was taken ashore for straightening. Navigation was supported by a new Main Chain Decca/lat,long convertor linked to the track plotter. This system functioned well and is now a routine operation used by the bridge officers.

EQUIPMENT LOSSES

During the course of the cruise four shipek grabs were lost. All four were lost due to operator error in three cases exacerbated by severe weather conditions.

The losses occurred as follows :-

| | |
|---|---|
| 29.4.83 | Grab pulled into the davit top snapping the wire. |
| 30.4.83 | Grab lost after snagging in the bilge heel. Ship drifting in strong winds. |

1.5.83 Grab pulled into the davit top during severe weather.

6.5.83 Grab lost after catching in coring platform while being brought inboard. Ship rolling heavily in poor conditions.

Losses at this level are unacceptable and it would seem appropriate that some effort should be made to introduce fail safe precautions. A number of grabs are lost each year almost always due to human error, often in difficult working circumstances. Unless additional precautions are introduced further losses are inevitable.

A number of options are available and these are being investigated. At the moment the most reliable would seem to be to reduce the relief valve pressure below the breaking strain of the wire. This however is not a simple job and there are a number of disadvantages. Other tripping methods are being considered.

## Ship Operations

In general the ship functioned well. Significant problems were encountered however in both power packs supplying the A frame and main hoist winch and a major overhaul is required during the port call. A number of deck lights also failed during the cruise and these will require repair or replacement. During the cruise considerable wear developed in the roll bar over which the drill is hauled inboard and remedial action is required also during the port call. As in previous seasons the ship rolls heavily in moderate seas and this remains a significant constraint on limiting working conditions.

## Conclusion

Overall this was a successful cruise despite the weather downtime. It is particularly gratifying to see the 6 m rock drill complete the initial development phase and become fully operational where it can now make a significant contribution to the geological survey. The extension of existing links with the Royal Scottish Museum is also gratifying. Miss Chambers has established collecting procedures on board and material can now be collected and appropriately treated by IGS staff for the

biologists as the programme permits. Utilisation of ship facilities in this way is beneficial to both parties and will hopefully be developed in the future.

The routine use of the Decca/lat, long convertor has considerably changed the roll of the bridge surveyor and consideration needs to be given to this function in the future.

# APPENDIX I

# APPENDIX I

| | |
|---|---|
| Wednesday 27.4.83 | |
| 00.00 - 08.00 | On passage for Scrabster |
| 08.00 - 24.00 | Alongside in Scrabster |
| | |
| Thursday 28.4.83 | |
| 00.00 - 20.30 | Alongside in Scrabster |
| 20.30 - 24.00 | On passage for work area - Fair Isle Sheet |
| | |
| Friday 29.4.83 | |
| 00.00 - 08.00 | On passage for work area |
| 08.00 - 21.50 | Drilling using 6 m rock drill |
| 21.50 - 24.00 | Gravity coring |
| | |
| Saturday 30.4.83 | |
| 00.00 - 08.00 | Gravity coring |
| 08.00 - 22.40 | Drilling with 6 m drill |
| 22.40 - 24.00 | Gravity coring |
| | |
| Sunday 1.5.83 | |
| 00.00 - 08.00 | Gravity coring |
| 08.00 - 22.25 | Drilling with the 6 m drill |
| 22.25 - 24.00 | Gravity coring |
| | |
| Monday 2.5.83 | |
| 00.00 - 08.00 | Gravity coring |
| 08.00 - 21.50 | Drilling with 6 m drill |
| 21.50 - 24.00 | Complete drilling begin gravity coring |
| | |
| Tuesday 3.5.83 | |
| 00.00 - 06.45 | Gravity coring |
| 06.45 - 11.00 | Abandon coring in poor weather and steam → shelter |
| 11.00 - 24.00 | Waiting on weather. At anchor in Quendale Bay |
| | |
| Wednesday 4.5.83 | |
| 00.00 - 06.45 | Waiting on weather |
| 06.45 - 22.10 | Drilling with 6 m drill |
| 22.10 - 24.00 | Gravity coring |

Thursday 5.5.83

| | |
|---|---|
| 00.00 - 07.20 | Gravity coring |
| 07.20 - 20.30 | Drilling with 6 m rock drill |
| 20.30 - 24.00 | Gravity coring |

Friday 6.5.83

| | |
|---|---|
| 00.00 - 06.00 | Gravity coring |
| 06.00 - 10.00 | Waiting on weather - steaming to shelter |
| 10.00 - 24.00 | Anchor in St Ninian's Bay |

Saturday 7.5.83

| | |
|---|---|
| 00.00 - 08.30 | Waiting on weather. Sheltering in St Ninian's Bay |
| 08.30 - 14.00 | Steaming to sampling site and waiting on weather |
| 14.00 - 14.30 | Gravity coring |
| 14.30 - 21.40 | Drilling with 6 m drill |
| 21.40 - 24.00 | Gravity coring |

Sunday 8.5.83

| | |
|---|---|
| 00.00 - 08.30 | Gravity coring |
| 08.30 - 23.30 | Drilling with 6 m drill |
| 23.30 - 24.00 | Gravity coring |

Monday 9.5.83

| | |
|---|---|
| 00.00 - 07.30 | Gravity coring |
| 07.30 - 12.50 | Drilling with 6 m drill |
| 12.50 - 19.40 | Gravity coring |
| 19.40 - 24.00 | Abandon coring and steam to shelter W of Orkney |

Tuesday 10.5.83

| | |
|---|---|
| 00.00 - 09.00 | Standing by waiting on weather |
| 09.00 - 10.00 | Attempt to anchor in heavy swell |
| 10.00 - 15.30 | Gravity coring |
| 15.30 - 16.00 | Lower drill to spin out the main hoist wire |
| 16.00 - 20.00 | Steam towards Dunnet Bay |
| 20.00 - 24.00 | Anchored in Dunnet Bay, waiting for weather |

Wednesday 11.5.83

| | |
|---|---|
| 00.00 - 07.10 | At anchor. Waiting on weather |
| 07.10 - 08.30 | Steam to Scrabster |
| 08.30 - 24.00 | Alongside in Scrabster |

# APPENDIX II

SHIP : WHITETHORN DATES : 28th April - 11th May LEG NO : 2 SHEET NOS :

| | DATE | 28/4 | 29/4 | 30/4 | 1/5 | 2/5 | 3/5 | 4/5 | 5/5 | 6/5 | 7/5 | 8/5 | 9/5 | 10/5 | TOTAL | TOTALS % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Working Time | In Port | 20.5 | | | | | | | | | | | | | 20.5 | 6.57 |
| | On passage | 3.5 | 7.6 | | | | | | | | 4.7 | | | 8.2 | 24 | 7.69 |
| | Traversing | | 4.0 | 8.6 | 9.3 | 11.9 | 10.0 | 5.1 | 12.3 | 4.7 | 5.5 | 10.6 | 13.3 | 5.3 | 100.6 | 32.24 |
| | Anchoring | | 2.8 | 4.8 | 3.3 | 4.7 | | 4.6 | 4.8 | | 2.1 | 3.6 | 2.1 | 0.9 | 33.7 | 10.8 |
| | On Station | | 9.6 | 10.6 | 11.4 | 7.4 | 1.2 | 6.5 | 6.9 | 1.1 | 3.0 | 9.8 | 4.6 | 1.1 | 73.2 | 23.46 |
| Downtime | Weather | | | | | | 12.8 | 6.8 | | 18.2 | 8.7 | | 4.0 | 8.5 | 59 | 18.91 |
| | Rock Drill | | | | | | | 1.0 | | | | | | | 1.0 | 0.32 |
| No of Stations | Grab | | 3 | 12 | 13 | 13 | 7 | 5 | 18 | 6 | 3 | 10 | 16 | 7 | | 113 |
| | Rock Corer | | | | | | | | 3 | | | | | | | 3 |
| | Sediment Corer | | 1 | 9 | 10 | 9 | 7 | 1 | 12 | 6 | 1 | 5 | 11 | 7 | | 79 |
| | Drill (6 m) | | 2 | 4 | 3 | 4 | | 4 | 4 | | 2 | 4 | 2 | | | 29 |

# APPENDIX III

| Site No | Water Depth m | Deployment Time (mins) | Drilling Time (mins) | Penetration Achieved (m) | Core Recovered (m) | Overburden Drilled (m) | Solid Drilled (m) | Reason for Termination | Successful | Rock Type |
|---|---|---|---|---|---|---|---|---|---|---|
| 59-01/219 | 121 | 70 | 34 | 4.64 | 0.60 | 4.4 | 0.24 | Drilled to refusal | ✓ | Soft calcareous sandstone |
| 59-01/220 (1st Att) | 131 | 55 | 18 | 1.83 | 0.35 | — | — | High system pressure | — | — |
| 59-01/220 (2nd Att) | 131 | 68 | 38 | 4.64 | 1.10 | 4.64 | — | Drilled to refusal | — | — |
| 59-01/229 (1st Att) | 126 | 55 | 18 | 2.05 | 0.40 | 2.05 | — | Drilled to refusal - high system pressure | — | — |
| 59-01/229 (2nd Att) | 126 | 45 | 10 | 2.54 | — | 2.54 | — | Refusal - bit blocked with sand | — | — |
| 59-01/230 (1st Att) | 127 | 40 | 12 | 1.0 | — | 1.0 | — | Bit blocked by pebble | — | — |
| 59-01/230 (2nd Att) | 127 | 45 | 15 | 0.93 | — | 0.93 | — | Bit blocked by pebble | — | — |
| 59-01/230 (3rd Att) | 128 | 40 | 8 | 1.10 | — | 1.10 | — | Refusal in gravel | — | — |
| 59-01/231 | 131 | 140 | 80 | 1.85 | 0.36 | 0.30 | 1.55 | Drilled to refusal | ✓ | Coarse red sandstone |
| 59-01/241 (1st Att) | 136 | 45 | 17 | 1.27 | 0.06 | 1.0 | 0.27 | Refusal - bit jammed with core fragment | ✓ | Coarse red sandstone |
| 59-01/241 (2nd Att) | 136 | 52 | 22 | 3.24 | — | ≈ 2.50 | ≈ 0.74 | Refusal - bit blocked open hole drilled | — | — |
| 59-01/242 | 129 | 50 | 10 | 4.82 | — | 4.82 | — | Drill to T.D. Rockead not reached | — | — |
| 59-01/243 | 120 | 50 | 20 | 3.71 | 0.19 | 3.20 | ≈ 0.50 | Refusal | ✓ | Hard red sandstone |
| 59-01/244 | 132 | 58 | 18 | 3.34 | 0.80 | ≈ 2.10 | 1.24 | Ship dragging anchor | ✓ | Coarse pebbly sandstone and conglomerate |
| 59-01/260 | 121 | 67 | 37 | 1.98 | 0.90 | ≈ 1.0 | ≈ 0.98 | Drilled to target | ✓ | X laminated bioturbated hard red siltstone |
| 59-01/261 | 118 | 70 | 38 | 1.44 | ≈ 1.0 | ≈ 0.20 | ≈ 1.20 | Drilled to refusal | ✓ | Shattered hard green sandstone |

| Site No | Water Depth m | Deployment Time (mins) | Drilling Time (mins) | Penetration Achieved (m) | Core Recovered (m) | Overburden Drilled (m) | Solid Drilled (m) | Reason for Termination | Successful | Rock Type |
|---|---|---|---|---|---|---|---|---|---|---|
| 59-01/266 (1st Att) | 130 | 36 | 6 | 5.5 | 0.30 | 5.5 | — | Total depth - target not reached | — | — |
| 59-01/266 (2nd Att) | 130 | 40 | 8 | 5.5 | 0.15 | ≥ 5.2 | 0.3 | Drilled to total depth | ✓ | brick red soft friable fine sandstone |

| Site No | Water Depth m | Deployment Time (mins) | Drilling Time (mins) | Penetration Achieved (m) | Core Recovered (m) | Overburden Drilled (m) | Solid Drilled (m) | Reason for Termination | Successful | Rock Type |
|---|---|---|---|---|---|---|---|---|---|---|
| 59-02/250 (1st Att) | 110 | 55 | 25 | ≈ 2.0 | Nil | 2.0 | — | Refusal in gravel | — | — |
| 59-02/250 (2nd Att) | 111 | 83 | 18 | ≈ 4.0 | 0.52 | < 3.80 | > 0.20 | Refusal | ✓ | Soft red sandstone |
| 59-02/251 (1st Att) | 121 | 55 | 19 | 4.06 | 1.0 | 4.06 | — | Refusal in gravel | — | — |
| 59-02/251 (2nd Att) | 121 | 55 | 21 | 2.99 | 1.0 | 0.97 | 0.03 | Refusal | ✓ | Brecciated siliceous sandstone |
| 59-02/251 (3rd Att) | 121 | 80 | 46 | 2.0 | 1.94 | 0.04 | 1.90 | Target reached | ✓ | Brecciated siliceous sandstone |
| 59-02/253 | 130 | 70 | 35 | 3.15 | 2.0 | 1.15 | 2.00 | Target reached | ✓ | Soft red sandstone |
| 59-02/254 | 118 | 60 | 24 | 1.92 | — | 1.92 | — | Bit jammed by pebble | — | — |
| 59-02/256 | 85 | 40 | 16 | 2.05 | 0.03 | 1.75 | 0.30 | Drilled to refusal - probable solid | ✓ | Granite |
| 59-02/257 (1st Att) | 108 | 40 | 10 | 5.50 | 0.20 | 5.50 | — | Solid not reached | — | — |
| 59-02/257 (2nd Att) | 108 | 37 | 7 | 5.50 | — | 5.50 | — | Solid not reached | — | — |
| 59-02/258 | 96 | 75 | 45 | 1.75 | — | 0.40 | 1.35 | Drilled to refusal | ✓ | Hard dark red X laminated sandstone |
| 59-02/259 (1st Att) | 108 | 37 | 7 | 5.50 | 0.25 | 5.25 | 0.25 | Drilled to T.D. | ✓ | v. soft friable red sandstone and soft siltstone |
| 59-02/259 (2nd Att) | 108 | 37 | 7 | 5.50 | 0.20 | 5.30 | 0.2 | Drilled to T.D. | ✓ | v. soft friable red sandstone and soft siltstone |
| 59-02/272 | 82 | 35 | 7 | 0.71 | 0.05 | ≈ 0.60 | 0.11 | Drilled to refusal - ? bit blocked | ✓ | hard grey fractured sandstone |
| 59-02/273 | 102 | 70 | 40 | 2.44 | 0.70 | 1.74 | 0.70 | Drilled to target | ✓ | hard purplish siltstone |
| 59-02/274 | 118 | 55 | 23 | 4.40 | 0.95 | 2.75 | 1.65 | Drilled to target | ✓ | very friable purplish and whitish v. coarse sandstone |

# DRILLING SUMMARY

**SITE NO :** 59-02/251 (Attempt 3) **DATE :** 29/4/83 **WATER DEPTH :** 121 m

**OBJECTIVE :** Probable Devonian (ORS) forming local ridge under thin sedimentary cover

**BIT TYPE :** Surface Set Diamond Bit **DEPLOYMENT TIME :** ≃ 80 mins

**DRILLING TIME :** 46 mins **PENETRATION ACHIEVED :** 2.0 m

**CORE RECOVERED :** 1.94 m. Approximately 5 cm of overburden (no recovery) over 1.9 m of very fine grained hard siliceous and probably decalcified rock with a brecciated/cataclastic texture with common veining and vug development with recrystalisation including calcite.

**COMMENT :** Site moved approx 50 m astern. Steady drilling under v. thin sediment cover. Core quality good. Bit wear negligible.

# DRILLING SUMMARY

SITE NO : 59-02/253 DATE : 30/4/83 WATER DEPTH : 130 m

OBJECTIVE : Permo-Trias under thin sediment cover

BIT TYPE : T. Insert Bit DEPLOYMENT TIME : 70 mins

DRILLING TIME : 35 mins PENETRATION ACHIEVED : 3.15 m

CORE RECOVERED : 2.0 m. Overburden 1.15 m with 2.0 m of reddish brown fine silty sandstone with greenish grey reduction patches. Soft weathered top. Permo-Triassic.

COMMENT : Bit wear negligible.

# DRILLING SUMMARY

SITE NO : 59-02/254 DATE : 30/4/83 WATER DEPTH : 118 m

OBJECTIVE : To prove Permo-Trias under a thin sediment cover.

BIT TYPE : T. insert bit. DEPLOYMENT TIME : 60 mins

DRILLING TIME : 24 mins PENETRATION ACHIEVED : 1.92 m

CORE RECOVERED : Nil. Pebbles jamming bit. Rockhead probably near 1.9 m when bit jammed.

COMMENT : Penetrometer hunting and changeing target at 1.7 m penetration. Bit blocked and jammed.

# DRILLING SUMMARY

SITE NO : 59-02/256 DATE : 4/5/83 WATER DEPTH : 85 m

OBJECTIVE : To prove rock type on E side of Walls Boundary Fault.

BIT TYPE : Surface Set Diamond Bit DEPLOYMENT TIME : 40 mins

DRILLING TIME : 16 mins PENETRATION ACHIEVED : 2.05 m

CORE RECOVERED : ?0.03 m + pebbles. Granite plug of possible solid under pebbles. Approx 1.6 m of overburden over solid. Probably approx 0.45m solid drilled considerable chippings of granite.

COMMENT : Drilled to refusal. Bit wear negligible.

# DRILLING SUMMARY

SITE NO : 59-02/257 (Attempt 1) DATE : 4/5/83 WATER DEPTH : 108 m

OBJECTIVE : To prove Permo-Trias under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 40 mins

DRILLING TIME : 10 mins PENETRATION ACHIEVED : 4.85 m

CORE RECOVERED : 20 cm of reddish-grey brown pebbly till.

COMMENT : Very rapid penetration to full extent of drill.

# DRILLING SUMMARY

SITE NO : 59-02/257 (Attempt 2) DATE : 4/6/83 WATER DEPTH : 108 m

OBJECTIVE : To prove Permo-Trias under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 37 mins

DRILLING TIME : 7 mins PENETRATION ACHIEVED : 4.85 m

CORE RECOVERED : Nil

COMMENT : Rockhead not reached. Bit wear negligible.

# DRILLING SUMMARY

SITE NO : 59-02/258 DATE : 4/5/83 WATER DEPTH : 96 m

OBJECTIVE : To prove Devonian (ORS) under a thin sediment cover

BIT TYPE : Surface Set Diamond DEPLOYMENT TIME : 75 mins

DRILLING TIME : 45 mins PENETRATION ACHIEVED : 1.75 m

CORE RECOVERED : 1.35 m. Approx 0.4 m overburden (no recovery) over 1.35 m dark brownish red hard X laminated sandstone.

COMMENT : Negligible bit wear. Complete recovery of solid.

# DRILLING SUMMARY

SITE NO : 59-02/259 (Attempt 1) DATE : 4/5/83 WATER DEPTH : 108 m

OBJECTIVE : To prove Permo-Trias under thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 37 mins

DRILLING TIME : 7 mins PENETRATION ACHIEVED : 5.5 m

CORE RECOVERED : Approx 0.25 m. Broken up friable red sandstone and soft siltstone - with scattered pebbles in the upper part.

COMMENT : Bit wear negligible. Probably into rock head.

# DRILLING SUMMARY

SITE NO : 59-02/259 (Attempt 2) DATE : 4/5/83 WATER DEPTH : 108 m

OBJECTIVE : To prove Permo-Trias under thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 37 mins

DRILLING TIME : 7 mins PENETRATION ACHIEVED : 5.5 m

CORE RECOVERED : Approx 0.2 m . Overburden probably 5.1 m thick (no recovery) Probably in situ but core badly disturbed very friable red sandstone and very soft deep red silty clay.

COMMENT : Bit wear negligible.

# DRILLING SUMMARY

SITE NO : 59-02/272 DATE : 5/5/83 WATER DEPTH : 82 m

OBJECTIVE : To core ORS under thin cover

BIT TYPE : Diamond, Surface Set DEPLOYMENT TIME : 35 mins

DRILLING TIME : 7 mins PENETRATION ACHIEVED : 0.71 m

CORE RECOVERED : Approx 0.05 m. Fractured grey dense sandstone - ORS.

COMMENT : Rapid penetration to 60 cm and then slow to refusal. Fragments in bit were badly shattered and may have jammed the bit.

# DRILLING SUMMARY

SITE NO : 59-02/273 DATE : 5/5/83 WATER DEPTH : 102 m

OBJECTIVE : To prove ORS under thin sediment

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 70 mins

DRILLING TIME : 40 mins PENETRATION ACHIEVED : 2.44 m

CORE RECOVERED : 0.70 cm. Approx 1.74 m overburden over hard dark purplish brown siltstone. No overburden recovery.

COMMENT : Rapid penetration of overburden. Drilled to target and stopped. Negligible bit wear.

# DRILLING SUMMARY

SITE NO : 59-02/274 DATE : 5/5/83 WATER DEPTH : 118 m

OBJECTIVE : To prove Permo-Trias under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 55 mins

DRILLING TIME : 23 mins PENETRATION ACHIEVED : 4.4 m

CORE RECOVERED : 0.95 cm. Rapid penetration to 2.75 m (probable overburden)
Very friable coarse purplish sandstone with greenish - white bands.

COMMENT : Bit wear negligible. Very friable sandstone.

# DRILLING SUMMARY

SITE NO : 59-02/275 DATE : 5/5/83 WATER DEPTH : 125 m

OBJECTIVE : To prove Permo-Trias under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 60 mins

DRILLING TIME : 28 mins PENETRATION ACHIEVED : 5.50 m

CORE RECOVERED : 0.05 m. Up to 2 m of disaggregated rock - very coarse sand - fine sand reddish and white - similar to v. coarse ? Triassic sands recorded earlier. Overburden probably 1 - 1.5 m thick.

COMMENT : Drilled to total depth. Rock disaggregated completely. Possibly due to high flushing rate. Both flushes in operation during drilling.

# DRILLING SUMMARY

SITE NO : 59-02/283 DATE : 8/5/83 WATER DEPTH : 137 m

OBJECTIVE : To core Permo-Trias under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 70 mins

DRILLING TIME : 38 mins PENETRATION ACHIEVED : 5.5 m

CORE RECOVERED : 2.30 m. Approx 1.2 m overburden (no recovery) over very friable - (weathered) purple red and greenish white med sandstone - very coarse and rarely pebbly sandstone.

COMMENT : Drilled to total depth.

# DRILLING SUMMARY

SITE NO : 59-02/284 (Attempt 1) DATE : 8/5/83 WATER DEPTH : 121 m

OBJECTIVE : To prove Lower Cretaceous under a thin cover

BIT TYPE : Surface Set Diamond DEPLOYMENT TIME : 50 mins

DRILLING TIME : 19 mins PENETRATION ACHIEVED : 5.5 m

CORE RECOVERED : 1.0 m. Overburden approx 4.9 m (1 m recovered) ? possibly drilled solid but no recovery. Red sandy and pebbly clay.

COMMENT : Drilled to total depth.

# DRILLING SUMMARY

SITE NO : 59-02/284 (Attempt 2) DATE : 8/5/83 WATER DEPTH : 123 m

OBJECTIVE : To prove Lower Cretaceous under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 60 mins

DRILLING TIME : 11 mins PENETRATION ACHIEVED : 5.5 m

CORE RECOVERED : 0.30 m. Shelly and pebbly clayey reddish sand.

COMMENT : Drilled to total depth. Recovery delayed when outer barrel slipped off top threads during retraction. Perhaps walking off during drilling (?insufficiently torqued up). Outer barrel jammed against inner and safely recovered.

# DRILLING SUMMARY

SITE NO : 59-02/285 (Attempt 1) DATE : 8/5/83 WATER DEPTH : 122 m

OBJECTIVE : To prove Permo-Trias under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 45 mins

DRILLING TIME : 15 mins PENETRATION ACHIEVED : 5.2 m

CORE RECOVERED : Nil. Overburden probably about 4.75 m.

COMMENT : Drill reached max torque and stopped at full drive pressure. No attempt made to restart as max reach had been achieved.

# DRILLING SUMMARY

**SITE NO :** 59-02/285 (Attempt 2) **DATE :** 8/5/83 **WATER DEPTH :** 122 m

**OBJECTIVE :** To prove Permo-Trias under a thin cover

**BIT TYPE :** Diamond Surface Set **DEPLOYMENT TIME :** 57 mins

**DRILLING TIME :** 27 mins **PENETRATION ACHIEVED :** 5.2 m

**CORE RECOVERED :** 0.20 cm. Red pebbly sandy clay ( Approx 4.4 m thick with 0.10 recovery) over v. coarse greenish white friable sandstone (0.10 cm recovery)

**COMMENT :** Reached max torque and stopped at full drive pressure.

# DRILLING SUMMARY

SITE NO : 59-02/295 DATE : 9/5/83 WATER DEPTH : 106 m

OBJECTIVE : To prove ORS under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 60 mins

DRILLING TIME : 29 mins PENETRATION ACHIEVED : 2.84 m

CORE RECOVERED : 1.40 m. Overburden Approx 1.4 m (no recovery) over fine - med brick red hard sandstone.

COMMENT : Thermal overload at 1.9 m (10 mins) Drill retracted and few cms and restarted. Site terminated due to ship drifting in wind and tide.

# DRILLING SUMMARY

SITE NO : 59-02/296 DATE : 9/5/83 WATER DEPTH : 112 m

OBJECTIVE : To prove Permo-Trias under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 51 mins

DRILLING TIME : 21 mins PENETRATION ACHIEVED : 4.75 m

CORE RECOVERED : 1.2 m. Approx 1.0 m of stiff - very stiff overconsolidated fissured grey clay with pebbly red sandy clay (?till) above (Approx 0.2 cm recovery)

COMMENT : Drilled to refusal. Bit probably blocking off and diamonds balling up in sticky clay.

# DRILLING SUMMARY

**SITE NO :** 59-01/219 **DATE :** 30/4/83 **WATER DEPTH :** 121 m

**OBJECTIVE :** Probably Upper Cretaceous clay under thin sediment cover

**BIT TYPE :** Tungsten Carbide insert bit **DEPLOYMENT TIME :** 70 mins

**DRILLING TIME :** 34 mins **PENETRATION ACHIEVED :** 4.64 m

**CORE RECOVERED :** 0.60 m. Approximately 4.4 m overburden. Pebbly (up to 5 cm) and shelly muddy sand over 0.4 m of bioturbated calcareous sandstone with belmnite fragment (?Cretaceous). Note muddy sand layers (Approx 10 cm) corresponds with increased penetration between 4.4 and 4.5 m.

**COMMENT :** Rapid penetration to 4.44 m and then slow to refusal at T.D. Bit wear negligible.

# DRILLING SUMMARY

SITE NO : 59-01/220 (Attempt 1) DATE : 30/4/83 WATER DEPTH : 131 m

OBJECTIVE : To sample probable Lower Cretaceous under a thin sediment cover

BIT TYPE : T.C. insert bit DEPLOYMENT TIME : 55 mins

DRILLING TIME : 18 mins PENETRATION ACHIEVED : 1.83 m

CORE RECOVERED : 0.35 m. Shell fragments over stiff sandy pebbly till with small shell fragments. Brownish grey in colour.

COMMENT : Drilling stopped because of high system pressure. Bit wear negligible.

# DRILLING SUMMARY

SITE NO : 59-01/220 (Attempt 2) DATE : 30/4/83 WATER DEPTH : 131 m

OBJECTIVE : To sample probable Lower Cretaceous under a thin sediment cover

BIT TYPE : T.C. insert bit DEPLOYMENT TIME : 68 mins

DRILLING TIME : 38 mins PENETRATION ACHIEVED : 4.64 m

CORE RECOVERED : 1.10 m. Dark grey/brown sandy pebbly clay (till) stiff-hard.

COMMENT : Site moved Approx 50 m astern. Drilled to refusal.

# DRILLING SUMMARY

SITE NO : 59-01/229 DATE : 1/5/83 WATER DEPTH : 126 m

OBJECTIVE : To prove Permo-Triassic under a thin sediment cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 55 mins

DRILLING TIME : 18 mins PENETRATION ACHIEVED : 2.05 m

CORE RECOVERED : 0.40 m. 20 cm of clayey silty sand over drained and resorted v. fine clayey sand v. hard and compact.

COMMENT : Thermal overloading with system pressure running high (3500 psi) Four thermal overloads with restarts before abandoning. Bit completely jammed by dense compacted sand blocking flushing and preventing further penetration. Bit wear negligible.

# DRILLING SUMMARY

SITE NO : 59-01/229 (Attempt 2) DATE : 1/5/83 WATER DEPTH : 126 m

OBJECTIVE : To prove Permo-Trias under a thin sediment cover

BIT TYPE : T.C. insert bit DEPLOYMENT TIME : 45 mins

DRILLING TIME : 10 mins PENETRATION ACHIEVED : 2.54 m

CORE RECOVERED : Nil

COMMENT : Thermal overloading due to high system pressure as in 1st attempt. Bit blocked and flushing unable to clear dense sand. Bit wear negligible. Site 50 m astern of attempt 1.

# DRILLING SUMMARY

SITE NO : 59-01/230 (Attempt 1) DATE : 1/5/83 WATER DEPTH : 127 m

OBJECTIVE : To prove Permo-Triassic under a thin sediment cover

BIT TYPE : T.C. insert bit DEPLOYMENT TIME : 40 mins

DRILLING TIME : 12 mins PENETRATION ACHIEVED : 1.0 m

CORE RECOVERED : Nil . A few pebbles of red (Triassic) sandstone.

COMMENT : No further penetration - penetrometer values hunting around 1 m penetration. Bit blocked with pebbles. No appreciable bit wear.

# DRILLING SUMMARY

SITE NO : 59-01/230 (Attempt 2) DATE : 1/5/83 WATER DEPTH : 127 m

OBJECTIVE : To prove Permo-Triassic sandstone under a thin cover

BIT TYPE : T.C. insert bit DEPLOYMENT TIME : 45 mins

DRILLING TIME : 15 mins PENETRATION ACHIEVED : 0.93 m

CORE RECOVERED : Nil. Pebbles blocking off bit.

COMMENT : No penetration - bit blocked in gravel bed. Drill making no progress site abandoned. Site 50 m astern of 1st attempt.

# DRILLING SUMMARY

SITE NO : 59-01/230 (Attempt 3) DATE : 1/5/83 WATER DEPTH : 128 m

OBJECTIVE : Permo-Triassic under sediment cover

BIT TYPE : T.C. insert bit DEPLOYMENT TIME : 40 mins

DRILLING TIME : 8 mins PENETRATION ACHIEVED : 1.10 m

CORE RECOVERED : Nil

COMMENT : Drilled to refusal in gravel bed. Barrel jamming severely with excentric revolution. Vibration mode used with barrel slightly retracted in case bit blocked. Refusal problem appears to be in ability to penetrate gravel and not blocking off.

# DRILLING SUMMARY

SITE NO : 59-01/231 DATE : 1/5/83 WATER DEPTH : 131 m

OBJECTIVE : To prove Permo-Trias under a thin sediment cover

BIT TYPE : T.C. insert bit DEPLOYMENT TIME : 140 mins

DRILLING TIME : 80 mins PENETRATION ACHIEVED : 1.85 m

CORE RECOVERED : 0.36 m. v. thin overburden ( 30 cm) - not recovered over v. fine red - red brown sandstone passing down into coarse red and mottled greyish white sandstone with v. coarse pebbly red and greyish white sandstone. at base. P

COMMENT : Very slow penetration to refusal. Considerable bit wear.

# DRILLING SUMMARY

SITE NO : 59-01/241 (Attempt 1) DATE : 2/5/83 WATER DEPTH :136 m

OBJECTIVE : To prove Permo-Trias or Devonian under a thin sediment cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 45 mins

DRILLING TIME : 17 mins PENETRATION ACHIEVED : 1.27 m

CORE RECOVERED : 0.06 m. Very coarse red and whitish grey qtz sandstone under Approx 1 m of sediment (no recovery of sediment)

COMMENT : Drilled to refusal. Bit probably jammed with rotated core fragment.

# DRILLING SUMMARY

SITE NO : 59-01/241 (Attempt 2) DATE : 2/5/83 WATER DEPTH : 136 m

OBJECTIVE : To prove Permo-Trias/Devonian under a thin sediment cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 52 mins

DRILLING TIME : 22 mins PENETRATION ACHIEVED : 3.24 m

CORE RECOVERED : Nil. Some quartz pebbles with evidence of a sandstone similar to core fragment in 1st attempt.

COMMENT : Bit blocked by pebbles. Bit wear insignificant.

# DRILLING SUMMARY

SITE NO : 59-01/242 DATE : 2/5/83 WATER DEPTH : 129 m

OBJECTIVE : To prove Permo-Trias or ORS under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 50 mins

DRILLING TIME : 10 mins PENETRATION ACHIEVED : 4.82 m

CORE RECOVERED : Nil

COMMENT : Drilled to full extension. Rockhead not reached.

# DRILLING SUMMARY

SITE NO : 59-01/243 DATE : 2/5/83 WATER DEPTH : 120 m

OBJECTIVE : To prove Permo-Trias/ORS under a thin sediment cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 50 mins

DRILLING TIME : 20 mins PENETRATION ACHIEVED : 3.71 m

CORE RECOVERED : 0.19 + pebbles. Slightly calcareous hard red sandstone (0.19 m) with coarse pebbles also. Approx 3.20 m thick.

COMMENT : Drilled to refusal.

# DRILLING SUMMARY

SITE NO : 59-01/244 DATE : 2/5/83 WATER DEPTH : 132 m

OBJECTIVE : To prove Permo-Trias/Devonian under sediment cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 58 mins

DRILLING TIME : 18 mins PENETRATION ACHIEVED : 3.34 m

CORE RECOVERED : 0.80 m. Probably 2.10 m of overburden ( none recovered) over very coarse poorly cemented pebbly red and greyish white sandstone - conglomerate with pebbles. 5 cm.

COMMENT : Bit blocked by large pebble. Site abandoned - ship dragging anchor. Drill may have been dragged at same time drill cut out with thermal overload. Barrel slightly bent.

# DRILLING SUMMARY

SITE NO : 59-01/260 DATE : 7/5/83 WATER DEPTH : 121 m

OBJECTIVE : To core ORS or Permo-Trias below a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 67 mins

DRILLING TIME : 37 mins PENETRATION ACHIEVED : 1.98 m

CORE RECOVERED : 0.90 m. Overburden approx 1.0 m thick over hard X laminated and bioturbated red-chocolate siltstone.

COMMENT : Bit wear negligible. Very steady slow drilling at approx 2 cm/min.

# DRILLING SUMMARY

SITE NO : 59-01/261 DATE : 7/5/83 WATER DEPTH : 118 m

OBJECTIVE : To prove ORS under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 70 mins

DRILLING TIME : 38 mins PENETRATION ACHIEVED : 1.44 m

CORE RECOVERED : Approx 1 m. Overburden probably v. thin. Core badly shattered hard micaceous greenish sandstone X bedded.

COMMENT : Drilled to refusal - rock badly shattered and may have blocked off the barrel.

# DRILLING SUMMARY

SITE NO : 59-01/266 (Attempt 1) DATE : 8/5/83 WATER DEPTH : 130 m

OBJECTIVE : To prove ORS under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 36 mins

DRILLING TIME : 6 mins PENETRATION ACHIEVED : 5.5 m

CORE RECOVERED : Approx 0.3 m. Pebbles and fine - coarse sand. Sand fraction similar to the Permo-Triassic sands.

COMMENT : Rock head not reached.

# DRILLING SUMMARY

SITE NO : 59-01/266 (Attempt 2) DATE : 8/5/83 WATER DEPTH : 130 m

OBJECTIVE : To core ORS under a thin cover

BIT TYPE : Diamond Surface Set DEPLOYMENT TIME : 40 mins

DRILLING TIME : 8 mins PENETRATION ACHIEVED : 5.5 m

CORE RECOVERED : 0.15 m. Overburden approx 5.2 m (no recovery) on brick red - white v. soft friable sandstone. v. fine - medium.

COMMENT : Drilled to total depth.