

IGS CONTINENTAL SHELF UNIT II

NORTH SCOTTISH, MORAY FIRTH AND
SOUTH FORTIES AREAS

Cruise Report M V Whitethorn 23 June/25 July
1972

Cruise CSU II 72/W4

by

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INTRODUCTION

The cruise was run in two legs of 14 and 19 days respectively with a work programme planned for the North Scottish area (Fig 1). However, heavy swell conditions in the early part of each leg made working in this area impossible and so sites were drilled in the Moray Firth and South Forties areas instead (Fig 2). In general, however, the weather was exceptionally good throughout the period and drilling was attempted at 17 sites despite at times difficult swell and tide conditions.

For most of the cruise navigation was by Decca Main Chain 6C, aided by sextant and radar. An intermittent fault in the Decca RM 729 radar equipment and the fact that some of the sites were outside the maximum range of the Alpine Radar Ranging Transponders meant that this equipment could not be used for much of the time.

The following summary cruise sheets have been prepared in connection with the cruise.

UTM 1:100 000 Sheets

57°	30'	N/02°	W
57°	30'	N/03°	W
58°	00'	N/03°	W
58°	30'	N/03°	W
58°	30'	N/04°	W
58°	30'	N/05°	W
58°	00'	N/06°	W
58°	00'	N/07°	W
59°	00'	N/04°	W
59°	00'	N/05°	W
59°	00'	N/06°	W

OBJECTIVES

The principal objective of the cruise was to prove the age of a number of apparently linked sedimentary rock basins in the area west of Orkney and the north end of the Minch. A secondary objective was to establish the nature of the unconsolidated sediments resting on rockhead and to compare these to known deposits on land. In the event of bad weather it was planned to investigate the surficial sediments to the west and north of N Rona and the extent of the sand wave fields at the western end of the Pentland Firth. In practice, however, drilling operations were carried out throughout the cruise and little time was available for other work.

CRUISE SUMMARY

The ship left Aberdeen at 0030 hrs on Friday 23rd June and following adverse weather reports from the N Scottish area began drilling operations at site 72/22 in the Moray Firth at 1540 hrs (Fig 2). On succeeding days sites 72/23 and 72/24A were also drilled in the Moray Firth and on June 26th the ship steamed through the Pentland Firth into the N Scottish area running a pinger line (CSU II/72/W4, line 63) to site 72/25 (Fig 1).

Drilling operations continued until June 29th at sites 72/25 and 72/26. However, because of drilling problems, site 72/26 was abandoned and a pinger line (CSU II/72/W4, line 64) was run to site 72/27. Drilling continued until July 3rd when site 72/28 also had to be abandoned because of drilling difficulties. A vibrocorer sample (NS 241) was taken at IGS proposed drill site no 148 and then the ship returned to the Moray Firth through the Pentland Firth running an echo sounder line (CSU II/72/W4, line 65) on the night of July 3rd/4th. Site 72/24B was drilled on July 4th and 5th and the ship returned to Aberdeen at 1015 hrs on July 5th at the end of leg I.

On leg II the ship left Aberdeen at 0830 hrs on July 7th and as before, because of adverse weather reports from the N Scottish area began drilling in the Moray Firth on site 72/29 at 1700 hrs (Fig 2). Drilling operations continued until 12th July on sites 72/29, 72/30 and 72/31 in the Moray Firth and South Forties areas. On July 13th the ship steamed through the Pentland Firth again to the North Scottish area to site 72/32 with an echo sounder line (CSU II/72/W4, line 66) being run during part of the passage (Fig 1).

Drilling operations continued until July 23rd at sites 72/32, 73/33, 72/34, 72/35, 72/36 and 72/37. At site 72/32 a vibrocore sample was recovered using the Wimpey Hydracorer which was on trials, and site 72/35 was abandoned because of drilling problems before rockhead was reached.

Work in the N Scottish area was completed on July 23rd and the ship steamed for Liverpool. On the way south three Shipek Grab samples were collected in the Sea of the Hebrides. The samples were collected as part of a research programme being conducted in the Organic Geochemistry Department of Newcastle University.

Also on the way south further deep water trials were carried out with the Wimpey Hydracorer in the Irish Sea before the ship eventually docked in Liverpool at 1000 hrs on July 26th.

SUMMARY OF ACTIVITIES

1. Drilling operations were attempted at 17 sites, three of which were abandoned because of drilling difficulties.
2. Vibrocorer and Shipek Grab samples were taken at each of the drilling sites and in addition one vibrocore and 4 Shipek Grab samples were collected at other sites.
3. Approximately 124 km of ORE pinger traverse was run and the Atlas Deso Echo Sounder was used over about 143 km of traverse.

SUMMARY OF RESULTS

A summary log for each borehole is given in Appendix I. Several general points can be made however from the sites drilled during this cruise.

The extent of the lithologically similar Kimmerigian and Lower Cretaceous black silty mudstones in the Moray Firth has been more closely defined and the Upper Cretaceous Chalk which was predicted at sites 72/24A & B and 72/29 is now thought to outcrop farther east than had been expected.

At sites 72/30 and 72/31 (Fig 2) the red sandstones are most probably

Permo-Triassic in age rather than Old Red Sandstone and these sites provide further evidence of a belt of Permo-Triassic rocks stretching from Burghhead as far south as St Abbs Head, south of the Firth of Forth.

To the north of Scotland the red sandstones, siltstones and mudstones at sites 72/25, 72/27, ? 72/28, 72/32, 72/34 and 72/36 are probably also Permo-Triassic. They are unlike the Torridonian red beds of the west coast of Scotland though they do bear certain similarities to some of the red bed sequences of the Middle Old Red Sandstone of Orkney or the Upper Old Red Sandstone of Hoy. If ^{however} what appears to be a series of interconnected sedimentary basins in the North Scottish Area are in fact of New Red Sandstone age then it would seem that the north end of the Minch and the area west of Orkney has been a major area of Permo-Triassic sedimentation. The reddish mottled limestone at site 72/37 may be difficult to date, but it could represent a cornstone horizon in a red bed sequence.

The black shales from site 72/33 may well be Jurassic in age and form part of the younger Mesozoic rocks preserved towards the centre of the sedimentary basin at the north end of the Minch.

In the drift sequences black mud beds within or below the boulder clay at sites 72/32, 72/33 and possibly 72/36 may be interglacial or interstadial deposits similar to those described from the island of Lewis. The till deposits are commonly shelly and may have a high sand content. At some sites there may also be a considerable thickness of ?Recent sand above the boulder clay (BH 72/33).

EQUIPMENT PERFORMANCE

The cruise provided the first prolonged test for the wire line equipment since the technique has been introduced to the drilling programme, and in general the equipment must be regarded as extremely successful. A great deal was learned during the cruise and operating methods were constantly improved as the work progressed. From the experience gained however several general points can be made.

1. The rock roller bits were worn out quickly (after drilling as little as 13 m in one case) in the hard and stoney tills in the North Scottish area. An inner wire line string (with larger than BX rods) must be an essential part of the drilling equipment for future North Scottish work if rockhead is to be successfully reached.
2. For much of the time considerable problems were caused by the swell (mean swells varied from 0.5 to 3 m), despite the unusually calm weather throughout the cruise. In future an improved riser or combined riser and tugger winch system must be developed for further North Scottish work.
3. Core recovery rates were low (13% in drift and 35% in solid) despite deliberate attempts to make improvements during the cruise. This is a serious problem and strenuous efforts must be made to improve recovery rates as soon as possible.

During the cruise Wimpey carried out several trials of their deep water

vibrocorer, called the Hydracorer (? from Hydra, a many headed beast in Greek mythology !). Several engineering problems remain to be solved but the equipment on one occasion successfully penetrated 2.7 m of coarse gravel.

The ORE Pinger system was used with limited success during the cruise. As past experience has suggested the pinger does not have sufficient power to penetrate gravelly or sandy sea beds. Therefore in an area such as the North Scottish area where the bottom is almost everywhere covered with shelly sand or gravel penetration ~~was~~ very poor and the equipment operated merely as an echo sounder.

APPENDIX I

BOREHOLE LOG SUMMARIES

Note that latitude and longitude positions are subject to alteration following final correction and that estimates of ages of solid are based on lithology only. Results of palaeontological and other analyses will be published later in IGS Report Series.

BH 72/22 (Site No 87)

Sea area: Moray Firth, 5.25 Nm SSE of Wick Head

Water depth: 74 m

Position: 58° 22.25' N 02° 57.05' W

Log	0.0 - 3.0 m	Medium-coarse grade shelly sand
	3.00 - 11.00 m	Stiff grey and reddish brown buttery mud

ROCKHEAD

11.00-16.00 m Black slightly micaceous silty mudstone with thin lenses of white coarse silt or very fine sand. The lenses are commonly less than 2 mm thick. There is some evidence of bioturbation.

END OF HOLE

AGE ?Jurassic/Cretaceous

BH 72/23 (Site No 73)

Sea area: Moray Firth, 15 Nm N of Buckie

Water depth: 87 m

Position: 57° 56.20' N 02° 57.35' W

Log	Sea bed	Grey-green muddy very fine sand
	?- 8.00m	Dark grey stiff mud
	8.00 -10.00m	Red-brown stiff mud
	10.00-17.00m	Stiff, very dark grey boulder clay

ROCKHEAD

17.00-20.00m Black pyritic shale with very rare pebbles

END OF HOLE

AGE ?Lower Cretaceous

BH 72/24 A & B (Site No 77)

Sea area: Moray Firth, 17 Nm ESE of Wick Head

Water depth: 54 m

Position: 58° 18.70' N 02° 34.75' W

Log	0.00- 2.00m	Shelly fine sand
	2.00-20.00m	Compact dark grey boulder clay
	20.00-30.00m	Pale grey boulder clay with chalk fragments

ROCKHEAD

30.00-31.50m Massive black shales with small fragments of pyrite

END OF HOLE

AGE ?Lower Cretaceous

BH 72/25 (Site No 144)

Sea area: North Scottish, 17 Nm E of Cape Wrath

Water Depth: 84 m

Position: 58° 39.50' N 04° 27.30' W

Log	0.00- 2.50m	Shelly medium sand
	2.50- 6.00m	No recovery
	6.00-12.50m	Reddish-brown boulder clay

ROCKHEAD

12.50-19.00m Friable red slightly muddy fine sandstone

END OF HOLE

AGE ?Permo-Triassic

BH 72/26 (Site No 143)

Sea area: North Scottish, 24 Nm ENE of Cape Wrath

Water depth: 90 m

Position: 58° 44.80' N 04° 16.90' W

Log	0.00- 0.30m	Shelly fine sand
	0.30- 1.40m	Grey ? boulder clay
	1.40- 2.80m	Reddish brown boulder clay
	2.80- 8.00m	No recovery

END OF HOLE

ROCKHEAD NOT REACHED

BH 72/27 (Site No 145)

Sea area: North Scottish, 14 Nm WSW of Dunnet Head

Water depth: 84 m

Position: 58° 38.10' N 03° 50.75' W

Log	0.00- 4.60m	Shelly fine-very fine sand
	4.60- 7.50m	No recovery
	7.50-18.00m	Grey sandy ? boulder clay

ROCKHEAD

18.00-29.30m Soft, friable red fine sandstone

END OF HOLE

AGE ? Permo-Triassic

BH 72/28 (Site No 123)

Sea area: North Scottish, 8.5 Nm S of Sule Skerry

Water depth: 74 m

Position: 58° 56.50' N 04° 22.25' W

Log	0.00- 0.20m	Shelly coarse sand
	0.20- 1.00m	Red sandy boulder clay
	1.00- 3.00m	No recovery except for washings of red and green silty mudstone

END OF HOLE

? ROCKHEAD AT 2.00m

AGE ?Permo-Triassic

BH 72/29 (Site No 76)

Sea area: Moray Firth, 20 Nm NNE of Banff

Water depth: 79 m

Position: 57° 59.05' N 02° 20.00' W

Log	00.00-00.60m	Grey, fine-very fine sand
	00.60-31.00m	Stiff very dark grey boulder clay

ROCKHEAD

31.00-35.50m	Black silty mudstone with thin lenses of fine sand which may be disturbed by bioturbation
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END OF HOLE

AGE	? Lower Cretaceous
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BH 72/30 (Site No 81)

Sea area: South Forties, 9.5 Nm NE of Frazerburgh

Water depth: 90 m

Position: 57° 46.95' N 01° 46.00' W

Log	00.00-00.35m	Shelly medium-coarse sand
	00.35-05.50m	Dark grey-black boulder clay
	05.50-15.00m	Stiff black mud with relatively rare red fine sand lenses
	15.00-24.00m	Coarse 'stoney' boulder clay or gravel

ROCKHEAD

24.00-30.00m	Friable red fine sandstone with green reduction spots and clasts of red mudstone interbedded with thin layers of red mudstone
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END OF HOLE

AGE	? Permo-Triassic
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BH 72/31 (Site No 120)

Sea area: South Forties, 7 Nm W of Peterhead

Water depth: 85 m

Position: 57° 31.45' N 01° 32.83' W

Log	00.00-00.35m	Poorly sorted shelly and pebbly sand
	00.35-24.00m	Dark grey-black boulder clay
	24.00-33.00	No recovery
	33.00-35.00m	Gravelly sand

ROCKHEAD

35.00-38.00m	Poorly sorted muddy and pebbly red fine sandstone with white and green reduction patches
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END OF HOLE

AGE	? Permo-Triassic
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BH 72/32 (Site No 142)

Sea area: North Scottish, 4 Nm ENE of Tolsta Head, Lewis

Water depth: 86 m

Position: 58° 22.2' N 06° 3.3' W

Log	00.00-00.20m	Grey fine sand
	00.20-23.50m	Dark grey stiff, boulder clay
	23.50-28.00m	Dark grey-dark grey brown mud with ? carbonaceous streaks and disarticulated nacreous shells

ROCKHEAD

28.00-36.00m	Brick red, poorly cemented, soft red fine- very fine sandstone
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END OF HOLE

AGE	?Permo-Triassic
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BH 72/33 (Site No 141)

Sea area: North Scottish, 16.5 Nm SW of Cape Wrath

Water depth: 84 m

Position: 58° 28.45' N 05° 26.55' W

Log	00.00-20.00m	Fine sand
	20.00-28.50m	Dark grey shelly boulder clay
	28.50-31.50m	Black sticky mud with delicate articulated shells and rare small pebbles
	31.50-36.80m	Dark grey-black boulder clay including grey limestone pebbles

ROCKHEAD

36.80-38.00m	Massive black mudstone with small fragments of pyrites
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END OF HOLE

AGE	?Jurassic
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BH 72/34 (Site No 138)

Sea area: North Scottish, 2 Nm SE of Nun Rock

Water depth: 82 m

Position: 58° 51.45' N 04° 54.25' W

Log	Sea bed	Shell sand
	?-08.50m	Grey pebbly mud or boulder clay overlying compact red sandy boulder clay

ROCKHEAD

08.50-14.80m	Brick red bioturbated siltstone with disturbed fine sandy pods and lenses
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END OF HOLE

AGE	?Permo-Triassic
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BH 72/35 (Site No 129)

Sea area: North Scottish, 8 Nm SW of N Rona

Water depth: 82 m

Position: 59° 01.10' N 05° 58.90' W

Log	00.00-08.00m	Pebbly shell sand
	08.00-10.00m	Brown pebbly boulder clay passing down into dark blue-grey-black boulder clay with large cobbles of hornblende gneiss
	10.00-14.00m	Coarse cobble boulder clay dark blue grey-black in colour with large cobbles of black hornblende gneiss

END OF HOLE
ROCKHEAD NOT REACHED

BH 72/36 (Site No 131)

Sea area: North Scottish, 8.5 Nm SE of N Rona

Water depth: 84 m

Position: 59° 04.20' N 05° 35.80' W

Log	00.00-06.00m	Pebbly and shelly fine sand
	06.00-33.00m	Dark grey sandy and shelly boulder clay
	33.00-35.00m	Slightly shelly silty and sandy black mud
	35.00-39.00m	No recovery
	39.00-40.00m	Pebbly or gravelly red ? boulder clay
	ROCKHEAD	
	40.00-41.00m	Soft red marl

END OF HOLE
AGE ?Permo-Triassic

BH 72/37 (Site No 122)

Sea area: North Scottish, 4.5 Nm NNE of Sule Skerry

Water depth: 85 m

Position: 59° 9.48' N 04° 21.20' W

Log	00.00-23.00m	Coarse shelly and pebbly sand at least 60 cm thick overlying sand and muddy gravel or gravelly boulder clay
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ROCKHEAD
23.00-26.50m Mottled massive pink and creamy calcareous mudstone and calcilutite, possible brecciated and partly silicified

END OF HOLE
AGE Unknown

MORAY FIRTH/SOUTH

FORTIES AREAS



