INSTITUTE OF GEOLOGICAL SCIENCES

CSU II Report 72/3

IGS CONTINENTAL SHELF UNIT II

THE SEA OF THE HEBRIDES

Cruise Report M V Whitethorn 7 Apr/8 May 1972

Cruise CSU II 72/W2

by

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INTRODUCTION

The cruise was run in two legs of twelve and seventeen days broken by an extended port call in Ardrossan during which the Wimpey Hydrocorer was fitted. Prior to this port call 36 hours stand-by work was done in the Clyde.

Drilling was undertaken by George Wimpey & Co using wireline and shell and auger methods.

All position fixing was by Decca RM 729 Radar.

The following summary cruise sheets are being prepared for circulation:

UTM 1:100 000	56°N/06°W
	56°N/07°W
	56°30'N/07°W
	56°30'N/08°W
	57°N/08°W
	57°N/07°W

OBJECTIVES

1. Borehole Programme

Of the ten planned sites six were intended to investigate the Sea of the Hebrides Mesozoic basin; two lay in the Camasunary basin and a further two were planned to investigate local problems. (McQuillin and others, in press).

Apart from coring solid the holes were also intended to provide further information about later and post-glacial sedimentation.

2. Stand-by work

The following work was planned:

(a) Sampling sea floor outcrop with the IGS Midi Drill.
(b) The completion of a rockhead map and the further investigation of the solid geology of certain areas using a 3000J sparker.
(c) A more detailed investigation of known areas with thin sediment cover using an ORE Pinger.

CRUISE SUMMARY

7.4.72	0000	Depart Greenock
	1230	Pinger survey between Colonsay and Jura. Steam to site 42 (Eigg Island).
8.4.72	1000	On site 42, unfavourable forecast. Pinger survey of trenches around Small Isles.
	2120	Steam to anchor
9.4.72	0620	Steam to site 42, unfavourable forecast. Sample of solid recovered with Midi Drill from site north of Rhum.

	1930	Weather deteriorating. Steam to anchor in Sound of Mull.
10.4.72	1515	Pinger survey in Sound of Mull.
	1910	Return to anchor
11.4.72	0700	Attempt to use Midi Drill on shoals west and south of Ardnarmurchan, prevented by swell and gale force winds.
	1210	At anchor in Sound of Mull.
12.4.72	0630	Steam to site 42, successful borehole operation (BH 72/6).
13.4.72	0740	Steam to site 32, Benbecula.
	1300	Unsuccessful attempt at anchoring due to strong tides and Main Chain Decca fluctuations.
	2300	Commence Pinger/Sonar survey of glacial trenches off South Uist and Benbecula.
14.4.72	0700	Commence sediment sampling but stop as weather deteriorating.
	1115	At anchor Loch Skiport.
	1430	Improvement in weather, attempt mooring up again but unsuccessful.
	2200	At anchor Loch Skiport.
15.4.72	0630	Steam to site 34 (BH 72/7) south-west of Skye. Moor up but two successive coring barrels lost putting wireline system out of action. Attempts to retrieve these unsuccessful.
16.4.72	On site 34.	
17.4.72	0200	Water depth restriction of 60 m imposed. Steam to site 26 in the Clyde.
	1700	On site 26. Attempt to lay anchors unsuccessful due to poor holding.
	2110	Steam to sediment sample stations off Ballantrae.
18.4.72	0545	Steam onto site 26. Attempt to anchor unsuccessful due to poor holding. Steam to site 18 but unable to attempt mooring due to deterioration in weather. Steam to run Pinger Survey in Ayr-Hunterston area.
	2130	Finish Pinger Survey.
	2330	Start sediment sampling off Corsewell Point.
19.4.72	0605	Finish sampling, steam to Ardrossan.
20.4.72		Alongside Ardrossan, testing drilling rods, installing sparker and Wimpey Hydrocorer.
21.4.72		Alongside Ardrossan - wireline drilling rods taken off following tests which indicated a weakness at a welded joint in each rod.
22.4.72	0000	Depart Ardrossan
	1200	On site 38 (BH 72/8). Borehole operation using shell and auger called off after 3 m penetration due to swell.
23.4.72	1400	Steam to site 40 (BH 72/9) north of Ross of Mull. Successful borehole operation.

24.4.72		Borehole operation continuous.
25.4.72	2345	Steam to site 32, Benbecula.
26.4.72	0730	On site 32 (BH 72/10). Successful borehole operation.
27.4.72	0830	Steam to site 35 (BH 72/11), Tiree.
	1200	On site. Successful borehole operation.
28.4.72	0710	Off site. Weather deteriorating steam to anchor, Sound of Mull.
29.4.72		At anchor Sound of Mull. Severe gales.
30.4.72		At anchor Sound Mull. Severe gale 9 and storm 10 forecast.
1.5.72	0830	Land B Lynas, IGS at Craignure. Steam to Pinger survey in Firth of Lorne.
	1400	Recalled to Oban ot pick up Mr G Cooper (Techmation Ltd), coming to fit Gifft recorder.
	1600	Loch Linnhe, work on installing Gifft recorder and matching it with E.G. & G. sparker system.
	2150	At anchor Sound of Mull.
2.5.72	0530	Steam to site 38 (BH 72/8), carrying out Sparker/Pinger trials.
	1245	On site - successful borehole operation.
3.5.72		On site 38.
4.5.72	1405	Steam to Tiree, land Mr Cooper, steam to Pinger survey of trenches around Small Isles.
	2130	Commence Pinger survey.
5.5.72	0245	Pinger survey completed. Steam to site 153.
	0812	Borehole operation
	1405	Complete string of casing lost
	2030	Steam to Hawes Bank for Pinger survey.
6.5.72	0600	Complete survey, steam to Loch Scridain for trials of Wimpey Hydrocorer.
	1650	Pinger survey on Loch Scridain.
	1900	Steam to new Pinger survey area off Tiree.
7.5.72	0850	Complete survey, commence sediment sampling.
	1755	Sampling completed steam to Firth of Lorne.
8.5.72	0440	Commence Pinger Survey, Firth of Lorne.
	0930	Finish Pinger Survey.
	1100	Alongside Oban.

EQUIPMENT PERFORMANCE

Wireline Gear

This worked satisfacitorily on site 72/6. On site 72/7 a fracture occurred in the drilling string as the bit reached rockhead (which lay under 3 m of boulder clay). On a second attempt a fracture again occurred. Both fractures are thought to have been caused by stress on the rods at the sea floor. The loss of two core-barrels in this way put the wireline gear out of operation for the rest of the cruise.

Shell and auger gear

This worked satisfactorily on the remaining boreholes and on site 38 (BH 72/8) where igenous boulders were encountered in the overburden, the diamond drilling facility gave this system an advantage over the wireline system.

On site 153, the last site attempted, a complete string of casing was lost as it was entering the sea floor.

Midi Drill and Spirotechnique TV System

This equipment was successful on the single occasion it was used.

Atlas-Desco Echo Sounder

This worked successfully throughout.

ORE Pinger and Gifft recorder

This system worked reliably throughout the cruise and 460 km of line was run. During the second leg the recorder loaned by Messrs Techmation was replaced by the IGS recorder modified to record a dual sparker-pinger trace, the sparker circuits being designed to interface with an E.G.& G. sparker system. Although working satisfactorily in the pinger mode only a weak sea floor reflection was recorded in the sparker mode. In spite of work by Techmation during the second leg and by RVB at Oban the full system was still not operational at the start of the next cruise.

Marconi Weather Recorder

This was installed at the beginning of the second leg and worked satisfactorily.

Wimpey Hydrocorer

Initial trials were carried out in Loch Scridain and it was evident that further work needed to be carried out to improve handling.

SUMMARY OF RESULTS

1. Boreholes

Five boreholes were successfully completed and the logs are listed below;

BOREHOLE 72/6 East of Rudha nan Tri Clach

Decca Chain 6C position Red E 03.49
Purple A 63.13

Water depth 53 m

DRIFT -

1.	Compact grey/greenish grey clay	8.00 m
2.	Dark greenish grey clay with pebbles and cobbles of basalt and schist	10.00 m
3.	Cobbles and boulders	3.50 m

SOLID

4.	Fine grained, massive calcareous sandstone	1.00 m
	Total depth	22.50 m

BOREHOLE 72/9 North of the Ross of Mull

Decca Chain 3B position Red G 12.84
Green A 30.29
Purple A 77.53

Water depth 58.5 m

DRIFT

1.	Olive grey silty sand, loose	2.30 m
2.	Cohesive, very dark grey to black clay	41.70 m
3.	Dark grey, stiff clay with pebbles	6.00 m
4.	Sand and gravel	3.00 m
5.	Clay	15.00 m

MOINE

6.	Psammitic schist	4.50 m
	Total depth	72.50 m

BOREHOLE 72/10 Wiay Island, Benbecula

Decca Chain 6C position Red G 09.70
Purple H 77.54

Water depth 73 m

DRIFT

1.	Poorly sorted sand and gravel including many red sandstone and shale fragments	0.50 m

? NEW RED SANDSTONE

2.	Red brown mudstone with thin calcite veins	2.00 m
	Total depth	2.50 m

BOREHOLE 72/11 10.35 miles north of Tiree

Decca Chain 3B position Red H 01.99
Purple B 54.49

Water depth 71.5 m

DRIFT

1.	Stiff dark grey clay with lithic fragments	1.00 m
	TORRIDONIAN	
2.	Red Arkose	2.00 m
	Total depth	3.00 m

BOREHOLE 72/12 9.75 miles at 310° from Skerryvore

Decca Chain 3B position Red H 13.27
Purple J 75.41

Water depth 63.5 m

DRIFT

1.	Coarse shell sand	Sea bed
2.	Stiff, dark grey clay	22.50 m
3.	Cobbles and boulders	4.50 m
4.	Hard boulder clay	2.00 m
	LEWISIAN	
5.	Orthogneiss	0.80 m
	Total depth	29.80 m

These results are consistent with the interpretation of the solid geology in McQuillin, Binns and Kenolty. Of obvious interest is the presence of a red mudstone, believed to be of Permian age, close to the Outer Hebrides. The sheared nature of the rock is consistent with its proximity to the Minch Fault.

The clay sequences above rockhead will provide further information about late-glacial sedimentation. It is now evident that a well-defined sequence exists and attempts are being made by Palaeontology and Radio-Carbon dating to relate this to the late- and post-glacial sequence on land.

2. Stand-by work

Apart from the recovery of a core of basalt north of Rhum and trials of the Hydrocorer and Sparker standby time in the Sea of the Hebrides was spent using the Pinger and the gravity corer, the latter being used at selected sites controlled by the Pinger.

In the Clyde Pinger lines were run to supplement vibrocorer work done on the previous cruise for Hunterston Development Corporation; the routine sediment sampling sampling grid was extended southwards into the

The work in the Sea of the Hebrides confirmed the lack of late- and post-glacial sediment in some of the glaciated troughs and considerably improved knowledge of the distribution of these sediments. During a traverse across the trench north of Hawes Bank a sounding of 323 m was recorded, this being equal to the deepest soundings so far recorded on the British Continental Shelf. Soundings in the trench north-west of Ardnamurchan were also significantly deeper than those published.

P. E. BINNS
Senior Scientist

2nd August 1972

MOVEMENT OF IGS PERSONNEL

Cruise Period	IGS PERSONNEL P Binns	H Robertson	B Lynas[1]	G Cooper[2] (Techmation)
Leg 1	*	x		
Leg 2	*		Unitl 1 May	From 1 May to 4 May

* Senior scientist
1 B Lynas - trainee from Overseas Division
2 G Cooper - technician from Messrs Techmation Ltd

REFERENCE

McQUILLIN, R., BINNS, P.E. and KENOLTY, N. (in preparation). The Geology of the Sea of the Hebrides. Rep. Inst. geol. Sci.