Natural Environment Research Council

Institute of Oceanographic Sciences
Crossway, Taunton, Somerset. TA1 2DW

PROVISIONAL CRUISE REPORT

VESSEL: RRS Frederick Russell
Cruises No 16/83 and 18/83

CRUISE LOCATIONS: SW Approaches/Bay of Biscay and W Solent/English Channel

CRUISE PERIODS: 20 September - 1 October and 14 October - 4 November 1983

PERSONNEL:

Cruise 16/83

A D Heathershaw (Principal Scientist)	20 Sept - 1 Oct
J D Humphery	20 Sept - 1 Oct
P M Hooper	20 Sept - 1 Oct
D A Young	20 Sept - 1 Oct
Mrs D J Corns	20 Sept - 1 Oct
A A Read	20 Sept - 1 Oct
R W Powell (RVS)	20 Sept - 1 Oct
G W J Miller (RVS)	20 Sept - 1 Oct

Cruise 18/83

A D Heathershaw (Principal Scientist)	14 Oct - 4 Nov
J D Humphery	14 Oct - 4 Nov
P M Hooper	14 Oct - 4 Nov
Mrs D J Corns	14 Oct - 28 Oct
J M Codd	14 Oct - 28 Oct
D N Langhorne	28 Oct - 4 Nov
G P LeGood	28 Oct - 4 Nov
R A Haine	28 Oct - 4 Nov
P D Thorne	28 Oct - 4 Nov
A A Landa	28 Oct - 4 Nov
R W Powell (RVS)	14 Oct - 28 Oct
G W J Miller (RVS)	14 Oct - 28 Oct
J Hardisty (Bristol University)	14 Oct - 21 Oct
M Overs (Bristol University)	21 Oct - 28 Oct

OBJECTIVES: SW Approaches and Bay of Biscay

a) To deploy a recording current meter mooring in the vicinity of Melville Knoll (mooring Mk1, Fig 1) for long term current measurements (∿ 1 month) to study the vertical structure of tidal currents.

b) To deploy two Bristol University current meter moorings in the vicinity of Melville Knoll (moorings CM1 and CM2, Fig 1).

c) To deploy recording current meter moorings in the vicinity of La Chapelle Bank (moorings LCB1-4, Fig 2) for long term current measurements to study the interaction between internal waves and tidal currents at the shelf-break. Information was also required to study the relation between sediment transport directions and tidal flows at the shelf-edge.

d) To deploy a thermistor chain mooring, for long term measurements (∿ 1 month), in the vicinity of La Chapelle Bank (mooring TC1, Fig 2) to study temperature fluctuations associated with internal waves.

e) To carry out salinity and temperature measurements at mid-shelf edge locations using CTD, XBT and thermo-salinograph equipment. This work included measurements in Black Mud Canyon (see Fig 2).

f) To carry out underwater photography and sediment sampling at mid-shelf and shelf-edge locations (including gravity coring in Black Mud Canyon).

g) To deploy a Bristol University frame mounted near-bottom current meter and sediment trap at a location on La Chapelle Bank.

h) To carry out echosounding and sidescan sonar surveys at various shelf and shelf-edge locations and in the vicinity of all moorings, to determine the size, extent and asymmetry of bedforms.

i) To investigate internal wave structure at the shelf-break using acoustic techniques.

W Solent and English Channel

a) To carry out boundary layer flow measurements and observations of seabed gravel movement in the West Solent and at a location to the south of the Isle of Wight (see Fig 3).

Details of current meter and thermistor chain moorings, locations and deployment periods are given in Appendix A. Positions for boundary layer flow and seabed gravel movement studies are shown in Appendix B.

The work at Melville Knoll, La Chapelle Bank and Black Mud Canyon form part of a science vote funded project (SP51) on shelf sediment dynamics. The work in the W Solent and south of the Isle of Wight form part of science vote funded project (SP31) on seabed gravel movement.

EQUIPMENT PERFORMANCE:

a) Current meter and thermistor chain moorings:
All moorings were successfully deployed and recovered and no problems experienced with acoustic releases or mooring equipment in general. However, one current meter failed due to a tape take-up fault and a number of small plastic floats being used as additional sub-surface buoyancy failed at depth on mooring LCB1 in 500 m of water. No problems were experienced with the thermistor chain.

b) CTD equipment:
For this cruise a combination of RVS and University College of North Wales (UCNW) Grundy 9400 CTD equipment was used. Both sea units operated satisfactorily although the UCNW 9400 sea unit consistently read low on salinity by 4‰ and showed slight hysteresis (~ .3‰) during some profile measurements. Problems were also experienced with the RVS conductivity cell (later corrected) and with a damaged cable harness on the RVS unit. Regular checks on salinity and temperature were carried out using NIO water bottles and reversing thermometers. Salinities were determined on board using a Plessey portable bench salinometer. Early on in cruise 16/83 some problems were encountered with faulty wiring on the hydrographic winch slip ring assembly. This was later completely rewired and no further problems were experienced.

c) XBT and thermosalinograph equipment:
This equipment operated satisfactorily throughout both cruises and the opportunity was taken with the thermosalinograph to make comparisons with CTD observations and the measured salinities from water samples and temperatures from reversing thermometers.

d) Echosounding and sidescan sonar equipment:
PES(10 KHz) data was gathered routinely throughout the cruise with the PES fish deployed and no serious problems were experienced with this equipment or the MUFAX recorder . However, this work has again shown the difficulty of obtaining reliable depth information from the PES in slope and canyon areas due to beam width (20°) and side lobe effects. Additionally there were problems with obtaining a good bottom return echo in depths greater than 2500-3000 m, even with high gain settings on the PES.

The ship's Atlas 600 (33 KHz) echosounder was used during both cruises to investigate internal wave structure at the shelf-break and this proved relatively successful with some good records being obtained. However, for future work it would help considerably if an echosounder of this type could be situated in the scientific plot area. A Simrad EQ38 (33 KHz) echosounder was also used but gave results inferior to those of the Atlas 600.

Sidescan sonar observations were carried out using the IOS(T) EG & G 272 fish (105 KHz) with the RVS 259 winch and cable. The fish was streamed with and without a weight, the weight being found to have little affect on the amount of cable ($\sim$ 500-600 m) which was needed to bring the fish within 50 m of the seabed. Some good records were obtained, However, as was found last year, slow and uncontrollable changes in height of the fish above the seabed meant that consistently good high resolution coverage was not possible.

e) Sediment sampling and underwater photography:
No problems were experienced with sediment sampling equipment although one of the RVS Shipek grabs was so badly rusted and corroded that it was virtually unserviceable. Gravity coring equipment was operated successfully although damage to barrels meant that the coring programme in Black Mud Canyon could not be completed.

The IOS(T) UMEL 35 mm underwater camera was successfully deployed during both cruises at depths down to 875 m. Good results were obtained although early results showed that more oblique illumination was required to give improved detail of sea floor topography. Consequently the camera and flash unit were rearranged in the frame to achieve this, although with this arrangement it was no longer possible to keep the Benthos compass within the field of view of the camera, and consequently there is a loss of scale information in these pictures.

f) Boundary layer flow measurement and seabed gravel movement equipment:
With the exception of the electromagnetic flow meter system, all this equipment operated satisfactorily. Good velocity profile data were obtained together with observations of gravel movement using the underwater TV and self generated noise (SGN) probes. Only one electromagnetic flowmeter gave reliable results, records from the other being contaminated with electrical noise.

SHIP PERFORMANCE:

The ship again provided good accommodation and laboratory facilities. However, the 'Frederick Russell' is a poor seaboat and her inability to make fast passages and the uncomfortable motion for those onboard greatly reduces her effectiveness

as a research vessel. To some extent this is mitigated by her good sea-keeping qualities once on station.

On both these cruises no serious problems were experienced with deployment and recovery of moorings. However, for work of this type, there would seem to be a need for improved communications between the after deck and the bridge. In particular the view from the bridge of the after deck area is greatly restricted.

Throughout both cruises position fixing was by Decca main chain and satellite navigation. In addition to the usual dusk/dawn effects experienced with the Decca, satellite navigation failed to improve on the accuracy which could be obtained with the Decca during daylight hours (updates on satellite DRT positions following a 'fix', quite often gave positions 2-3 miles different from those previously calculated).

Precise interpretation of survey work, particularly overnight survey work, is greatly restricted by the lack of an accurate position fixing system on the RRS Frederick Russell.

For the work in the W Solent, the boundary layer rig was again successfully handled over the stern, of the vessel. The ship was held steady to the ebb and flood tides on a single bow anchor using the automatic pilot.

RESULTS:

SW Approaches and Bay of Biscay

The successful recovery of a total of 21 current meters which were deployed for a period of 1 month, has provided a comprehensive data set with which to examine the vertical structure of tidal currents, and the larger scale physical processes governing sediment movement at both mid-shelf and shelf-edge locations. These data together with results from the thermistor chain mooring will also enable further detailed studies to be made of the interaction between internal waves and tidal currents at the shelf-break.

A large amount of good quality CTD data and surface salinity and temperature measurements were obtained across the shelf-break. These results will also be used to study the tidal phase of generation of internal waves and their role in modifying sediment transport rates.

The results of this year's echosounding and sidescan sonar surveys will help to complete the interpretation of last year's results from the La Chapelle Bank area, as will the additional sediment samples obtained during these cruises. This year's underwater photography has also been very successful in adding to our knowledge of seafloor roughness on the shelf and at the shelf-edge. These results will be of value in interpreting the vertical structure of tidal currents at these locations.

Due to the success of cruise 16/83 some gravity coring work planned for next year, was brought forward and during cruise 18/83 two good cores were obtained from the continental slope in the vicinity of Black Mud Canyon. However, further coring work was prevented by damage to gravity corer barrels.

The 10 KHz PES was operated routinely throughout both cruises and approximately 1000 line miles of echosounding data obtained in the SW approaches and W English Channel (see Fig 3). These data

will be used to up-date existing maps of sandwave distribution and asymmetry and to delineate new areas of mobile sediment.

These new data will provide further valuable background information for deployments of IOS Taunton's remote recording sediment transport and boundary layer (flow measuring) equipment (STABLE) which it is hoped to deploy in May 1984.

West Solent

Good velocity profile and self generated noise (SGN) data were obtained from the W Solent (Fig 2) during the final leg of cruise 18/83. Corresponding underwater TV data was obtained during those periods when seabed gravel movement was observed to occur. However, the disappointing failure of one of the electromagnetic flowmeters meant that Reynolds stress measurements could only be made at one level above the seabed, although this will be sufficient for correlation analyses with TV and SGN data.

Velocity profile, turbulence, SGN and underwater TV observations were also carried out at a location to the S of the Isle of Wight. However, under the tidal conditions which prevailed at the time, no gravel movement was observed to occur. Further data collection was curtailed by rig handling problems.

ITINERARY: Cruise 16/83

20.9.83 IOS personnel join ship in Plymouth. RVS staff already onboard. Loaded remaining scientific equipment. Departure postponed due to adverse weather

21.9.83 0750 Sailed Plymouth for Melville Knoll
1940 Anchored Crow Sound, Isles of Scilly, to shelter from bad weather and prepare current meters and current meter moorings

22.9.83 0100 Weighed anchor and sailed Crow Sound for Melville Knoll
1005 Arrived Melville Knoll. Started wire tests on releases
1410 Completed tests on releases
1600 Standing by to start CTD observations. Problem with wiring on winch slip ring assembly cleared up
1705 Main engine stopped due to problem with cooling water. Ship not able to maintain position on station so abandoned further CTD work
2320 Main engine running again

23.9.83 0100 Back on station for CTD work.
0130 Started CTD casts at station MK1
0307 Completed CTD casts at MK1
0330 Started echosounding and sidescan sonar surveys
0800 Completed surveys
0930 Laid spar buoy at MK1
1210 Laid MK1 current meter mooring
1412 Laid CM2 current meter mooring (Bristol)
1434 Laid CM1 current meter mooring (Bristol)
1715 Started underwater camera work at MK1
1733 Completed camera work
1800 Started sediment sampling at MK1

1835 Completed sediment sampling
1850 Leave Melville Knoll area for La Chapelle Bank. Start echosounding and thermosalinograph surveys

24.9.83 0820 Arrived La Chapelle Bank area. Stopped survey work
0935 Started wire tests on releases for current meter moorings LCB1 and LCB 2
0955 Tests on releases completed
1134 Laid LCB1. Possibly picked up acoustic beacon from last year's LCB1 mooring which was lost in this area
1511 Laid LCB2
1641 Laid spar buoy on thermistor chain mooring TC1 position
1710 Started wire tests on release for TC1
1719 Completed tests on TC1 release
2023 Laid TC1
2040 Started overnight echosounding and thermosalinograph surveys

25.9.83 0700 Completed overnight survey work
0925 Started wire tests on releases for current meter moorings LCB3 and LCB4
0937 Completed wire tests
1034 Laid LCB3
1154 Laid LCB4
1345 Started CTD observations at TC1 and continued overnight

26.9.83 1320 Completed CTD work at TC1
1400 Started echosounding and sidescan survey work around LCB2, LCB3 and LCB4 mooring positions. Problems with connector on 259 winch
1820 Completed surveys
2007 Started 'drift' CTD observations across shelf-break and continued overnight

27.9.83 0825 Completed 'drift' CTD observations
0950 Continue echosounding and sidescan sonar surveys around mooring positions LCB2-LCB4
1600 Completed surveys
1648 Started camera work at LCB4
1656 Completed camera work
1724 Started sediment sampling at LCB4
1736 Completed sediment sampling
1933 Laid dahn buoy in approximate position of LCB1
2058 Started CTD work at LCB1, keeping station on dahn buoy, and continued overnight

28.9.83 0840 Completed CTD observations at LCB1
0902 Started sediment sampling at LCB1
0930 Completed sediment sampling
1031 Started camera work at LCB1
1046 Completed camera work
1110 Recovered dahn buoy
1232 Started camera work at LCB4
1245 Completed camera work
1409 Started camera work at LCB2
1422 Completed camera work
1445 Started sediment sampling at LCB2

1501 Completed sediment sampling and proceeded to Black Mud Canyon.
1928 Laid dahn buoy in head of Black Mud Canyon.
2002 Started CTD observations in Blak Mud Canyon and continued overnight.

29.9.83 0811 Completed CTD observations in Black Mud Canyon and started sediment sampling.
0830 Completed sediment sampling at head of Canyon.
0855 Recovered dahn buoy.
1047 Started echosounding and sidescan sonar survey around head of Black Mud Canyon.
1440 Completed survey.
1620 Started deep camera work in Black Mud Canyon.
1710 Completed camera work.
1910 Started XBT observations along axis of Canyon.
2230 Completed XBT observations and departed area for Plymouth. Echosounding and thermosalinograph surveys continued overnight and on passage.

30.9.83 1610 Recovered PES fish.
1930 Berthed Millbay Dock, Plymouth.

1.10.83 IOS Taunton personnel leave ship and return to Taunton.

Cruise 18/83

13.10.83 IOS Taunton personnel join ship in Plymouth. RVS staff already onboard.

14.10.83 1100 Sailed Plymouth but gale warnings in force in all sea areas so proceeded to Roscoff to shelter.

15.10.83 0015 Anchored off Roscoff.
1130 Berthed in Roscoff sheltering from gales.

16.10.83 Stormbound in Roscoff.

17.10.83 0900 Sailed Roscoff for La Chapelle Bank.
0950 Started echosounding and thermosalinograph surveys.

18.10.83 1015 Sighted spar buoy in TC1.
1100 Started CTD observations at TC1.
2340 Completed CTD observations.

19.10.83 0004 Started CTD observations on section between TC1 and LCB1.
0736 Completed CTD observations.
0911 Laid dahn buoy in approximate position of LCB1.
1245 Started CTD observations at LCB1.
2133 Completed CTD observations.
2156 Recovered dahn buoy.
2200 Started echosounding surveys and continued overnight.

20.10.83 0600 Completed surveys.
0632 Laid Bristol University current meter and sediment trap rig in LCB2 area.
0645 Proceeded to Black Mud Canyon.
0930 Started gravity coring in Black Mud Canyon.
1615 Completed coring work.
1905 Recovered Bristol rig from LCB2 position
1950 Started camera work on Bristol rig position.

2003 Completed camera work and proceeded to Roscoff.

21.10.83 0905 Recovered PES fish.
1125 Berthed Roscoff. Visit from students at Roscoff Marine Biological Research Station and tour of ship. Collected remains of old RVS current meter mooring.

22.10.83 0910 Sailed Roscoff for Melville Knoll.
1000 Deployed PES fish and started echosounding and sidescan sonar surveys.

23.10.83 0200 Arrived in vicinity of MK1 but could not locate spar buoy.
0340 Broke off search for spar buoy and commenced echosounding survey.
0810 Sighted MK1 spar buoy. Stopped echosounding survey work.
0940 Started CTD work at MK1.
1240 Completed CTD observations.
1332 Recovered MK1 current meter mooring.
1425 Recovered spar buoy.
1514 Started camera work at MK1.
1540 Completed camera work and proceeded to La Chapelle Bank. Started overnight echosounding and thermosalinograph work.

24.10.83 0920 Sighted TC1 spar buoy. Completed overnight survey work.
0954 Fixed position of TC1 spar buoy and proceeded to LCB1 position.
1035 Arrived LCB1 position.
1210 Recovered LCB1 current meter mooring. Proceeded to LCB2 position.
1552 Recovered LCB2 current meter mooring. Proceeded to TC1 position.
1655 Recovered TC1 thermistor chain mooring.
1807 Recovered TC1 spar buoy.
2100 Started echosounding and thermosalinograph surveys across shelf break.

25.10.83 0720 Completed survey.
0830 Arrived position of LCB3.
1118 Recovered LCB3 current meter mooring. Proceeded to LCB4 position.
1337 Recovered LCB4 current meter mooring. Proceeded back towards LCB1 position to look for mooring lost last year.
2200 Abandoned attempts to carry out overnight sidescan sonar work due to fault on EG & G cable.

26.10.83 0630 Resumed search for lost mooring.
1050 Abandoned search and proceeded to Plymouth continuing echosounding and thermosalinograph surveys overnight.

27.10.83 0500 Stopped overnight survey work.
0845 Berthed Millbay Dock, Plymouth.

28.10.83 In Plymouth. Exchange scientific personnel and unload and load scientific equipment.
2010 Sailed Plymouth for W Solent.

29.10.83 0930 Arrived Yarmouth Road. Launched inflatable to collect D N Langhorne from Yarmouth and set up Decca trisponder equipment.
1605 Anchored in position for boundary layer flow and seabed gravel movement studies.
2018 Started gravel measurements and continued overnight.

30.10.83 Continued gravel measurements.

31.10.83 Continued gravel measurements.

1.11.83 0830 Weighed anchor and moved closer to Isle of Wight shore to area of long wavelength gravel waves.
0927 Anchored in bedform area and continued gravel measurements throughout day and overnight.

2.11.83 1835 Weighed anchor and proceeded to position S of Isle of Wight in Freshwater Bay.
2003 Anchored in Freshwater Bay.
2150 Started boundary layer flow and gravel movement studies and continued overnight.

3.11.83 0604 Stopped gravel measurements.
0630 Weighed anchor and returned to flat bed area in W Solent.
0800 Anchored in flat bed area in West Solent and continued gravel measurements.
1417 Stopped gravel measurements.
1425 Weighed anchor and proceeded to Plymouth.

4.11.83 0440 Berthed Millbay Dock, Plymouth. Unload scientific equipment. IOS personnel leave ship and return to Taunton.

PREPARED BY: A D Heathershaw (A D HEATHERSHAW)

APPROVED BY: K R Dyer (K R DYER)

DATE: 21.11.83

APPENDIX A

Details of IOS current meter and thermistor chain mooring positions

	Decca (SW British)		Lat/Long (Sat. Nav. DRT only)	
Melville Knoll				
MK1	Red C12.87	Purp C63.53	49° 14.224'N	8° 29.680'W
La Chapelle Bank				
LCB1	Red GO.68	Green D46.54	47° 34.408'N	7° 16.728'W
LCB2	F22.47	D46.45	47° 40.388'N	7° 13.425'W
LCB3	F19.45	E31.24	47° 42.068'N	7° 17.131'W
LCB4	G4.64	D41.70	47° 35.839'N	7° 02.510'W
TC1	F23.58	D45.99	47° 39.547'N	7° 11.746'W

APPENDIX A

Details of heights of current meters and thermistor chains and deployment periods

Current Meter/ Thermistor Chain	Station	Depth (m)	Height (m)	Start (GMT)	Finish (GMT)	Sensors
Melville Knoll						
RCM 5228	MK1	145	115	2255/21/9/83	1800/23/10/83	C/T/P
6942			75	2235/21/9/83	1740/23/10/83	C/T
6939			50	2300/21/9/83	1730/23/10/83	C/T/P
5331			30	2305/21/9/83	1715/23/10/83	C/T
6751			15	2255/21/9/83	1700/23/10/83	C/T
6745			6	2305/21/9/83	1450/23/10/83	C/T
4779			2.5	2310/21/9/83	1515/23/10/83	C/T
3258			1	2235/21/9/83	--- *	C/T/P
La Chapelle Bank						
RCM 7064	LCB1	504	450	2045/23/9/83	1205/24/10/83	C/T/P
5916			250	2030/23/9/83	1310/24/10/83	C/T/P
4817			6	2055/23/9/83	1245/24/10/83	C/T
4820			3	2045/23/9/83	1300/24/10/83	C/T
3260			1.5	2030/23/9/83	1220/24/10/83	C/T/P
RCM 5318	LCB2	167	120	1235/24/9/83	2020/24/10/83	C/T/P
5912			35	1235/24/9/83	1945/24/10/83	C/T/P
5911			12.5	1220/24/9/83	1925/24/10/83	C/T
6753			5	1220/24/9/83	1900/24/10/83	C/T
5332			3	1220/24/9/83	1840/24/10/83	C/T
3261			1.5	1235/24/9/83	1915/24/10/83	C/T/P
RCM 7063	LCB3	175	1	0725/25/9/83	1320/25/10/83	C/T
RCM 5229	LCB4	175	1	0725/25/9/83	1300/25/10/83	C/T
TC 602/777	TC1	165	87/137	1820/24/9/83	1820/24/10/83	T/11

Notes:

RCM denotes recording current meter

TC denotes thermistor chain

RCM and TC heights are nominal only

The recording intervals for RCM and TC observations were 5 mins and 10 mins respectively

* Tape take-up fault on RCM 3258 No data

C/T/P denote conductivity, temperature and pressure sensors respectively

APPENDIX B

Locations of seabed gravel measurement studies in the W Solent and S of Isle of Wight

W Solent

Periods	Stage of Tide	Decca trisponder ranges (m) Yarmouth	Lymington
After anchoring	E	2240	2980
2018/29/10/83 - 0332/30/10/83	F	-- [a]	-- [a]
0526/30/10/83 - 0931/30/10/83	E	2240	2996
1236/30/10/83 - 1630/30/10/83	F	2362	3020
1852/30/10/83 - 2243/30/10/83	E	2313	2958
2352/30/10/83 - 0537/31/10/83	F	2375	3021
0707/31/10/83 - 1131/31/10/83	E	2280	2963
1256/31/10/83 - 1750/31/10/83	F	2360	3010
2011/31/10/83 - 2319/31/10/83	E	-- [b]	-- [b]
0938/1/11/83 - 1151/1/11/83	E	2250[c]	3195[c]
1346/1/11/83 - 1842/1/11/83	F	2360	3240
2031/1/11/83 - 0057/2/11/83	E	2248	3236
0232/2/11/83 - 0735/2/11/83	F	2350	3250
0852/2/11/83 - 1302/2/11/83	E	2280	3230
1450/2/11/83 - 1822/2/11/83	F	2373	3260
0950/3/11/83 - 1417/3/11/83	E	2303[d]	3022[d]

S Isle of Wight

Periods	Stage of tide	Decca Main Chain (SW British) Red	Purple
2150/2/11/83 - 0150/3/11/83	E	I10.82[e]	G78.52[e]
0433/3/11/83 - 0604/3/11/83	F	I10.95[e]	G78.61[e]

E ≡ Ebb F ≡ Flood

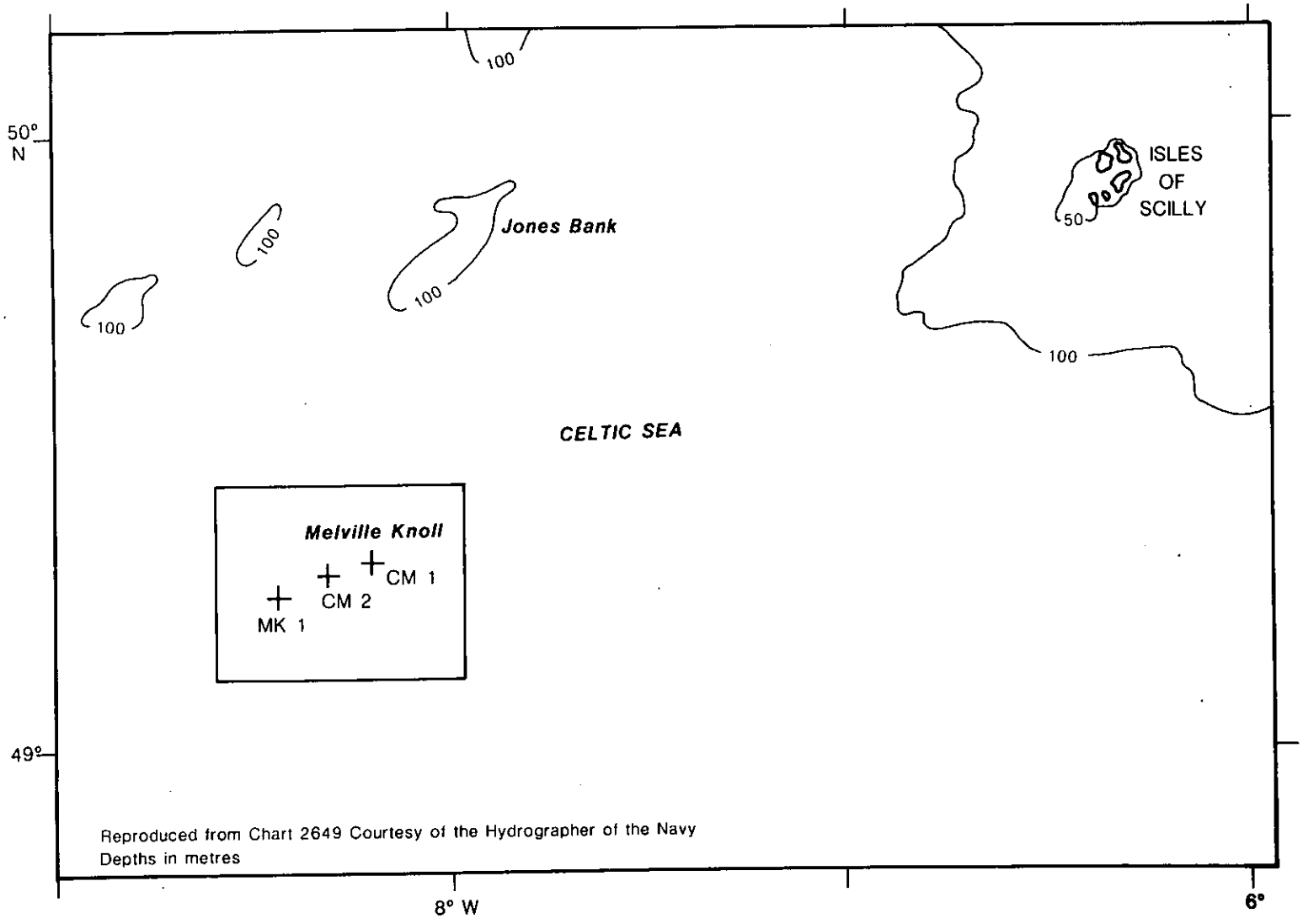
a. No trisponder data available

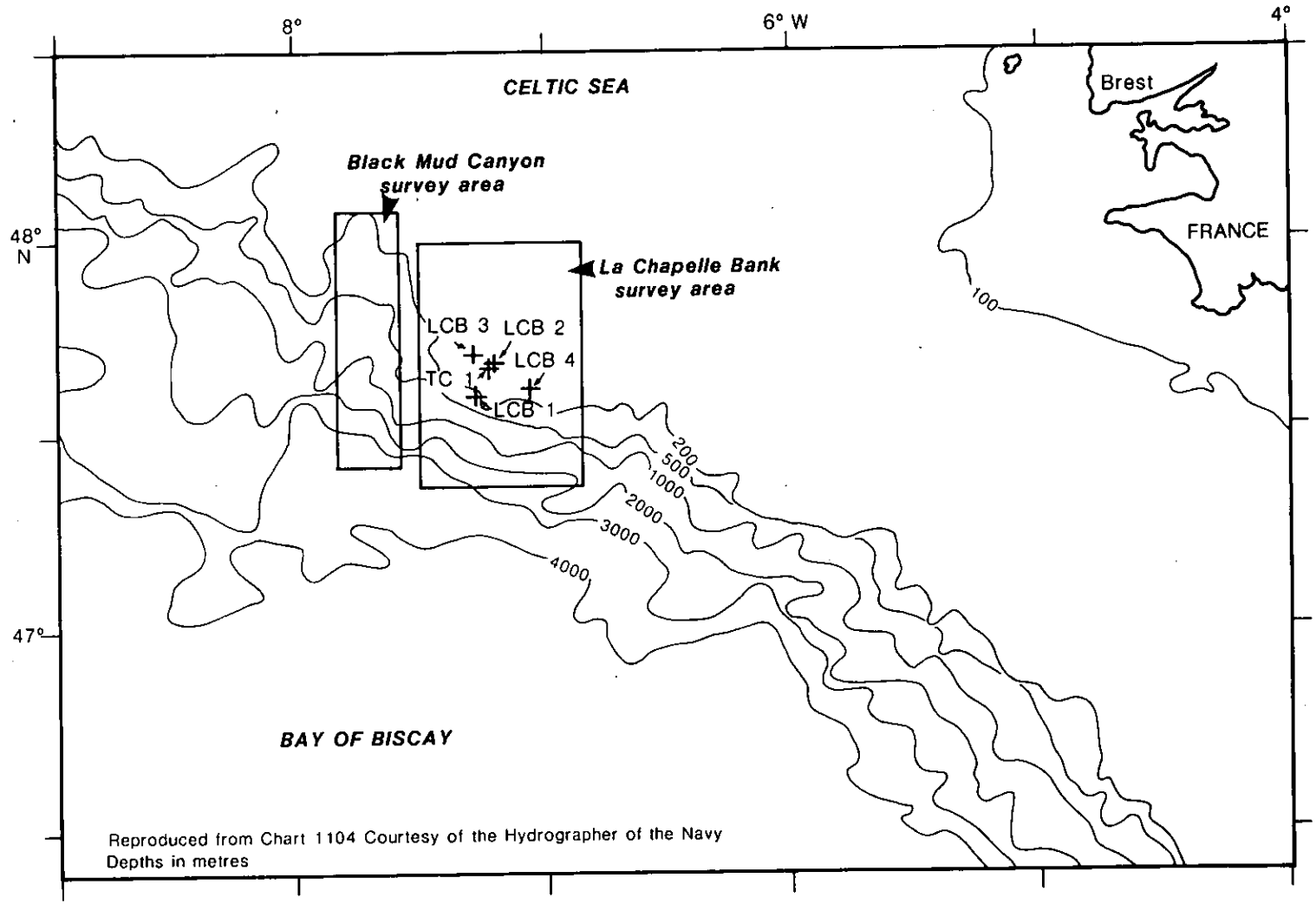
b. Trisponder u/s

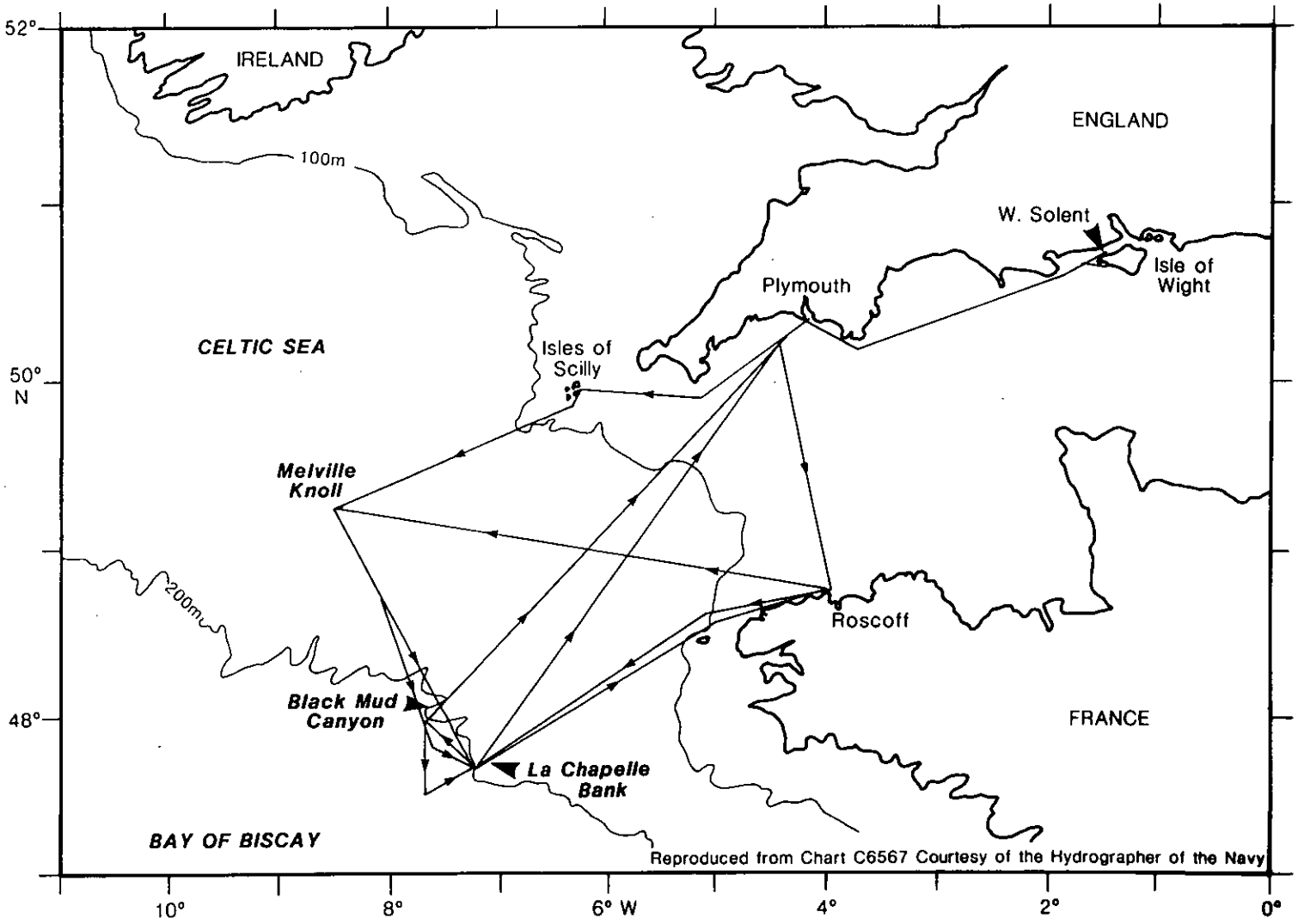
c. After re-anchoring closer to Isle of Wight shore on bedforms

d. After return from S of Isle of Wight and anchoring on flat bed area

e. No trisponder data. Remote at Needles Coast Guard not working.


50° N
49°
8° W
6°
100
100
100
100
100
50
Jones Bank
ISLES OF SCILLY
CELTIC SEA
Melville Knoll
CM 1
CM 2
MK 1
Reproduced from Chart 2649 Courtesy of the Hydrographer of the Navy
Depths in metres


8°
6° W
4°
CELTIC SEA
Brest
FRANCE
Black Mud Canyon
survey area
La Chapelle Bank
survey area
48°
N
LCB 3
LCB 2
LCB 4
TC 1
LCB 1
100
200
500
1000
2000
3000
4000
47°
BAY OF BISCAY
Reproduced from Chart 1104 Courtesy of the Hydrographer of the Navy
Depths in metres


52°
IRELAND
ENGLAND
100m
W. Solent
Isle of Wight
Plymouth
CELTIC SEA
Isles of Scilly
50° N
Melville Knoll
200m
Roscoff
Black Mud Canyon
FRANCE
La Chapelle Bank
BAY OF BISCAY
Reproduced from Chart C6567 Courtesy of the Hydrographer of the Navy
48°
10°
8°
6° W
4°
2°
0°