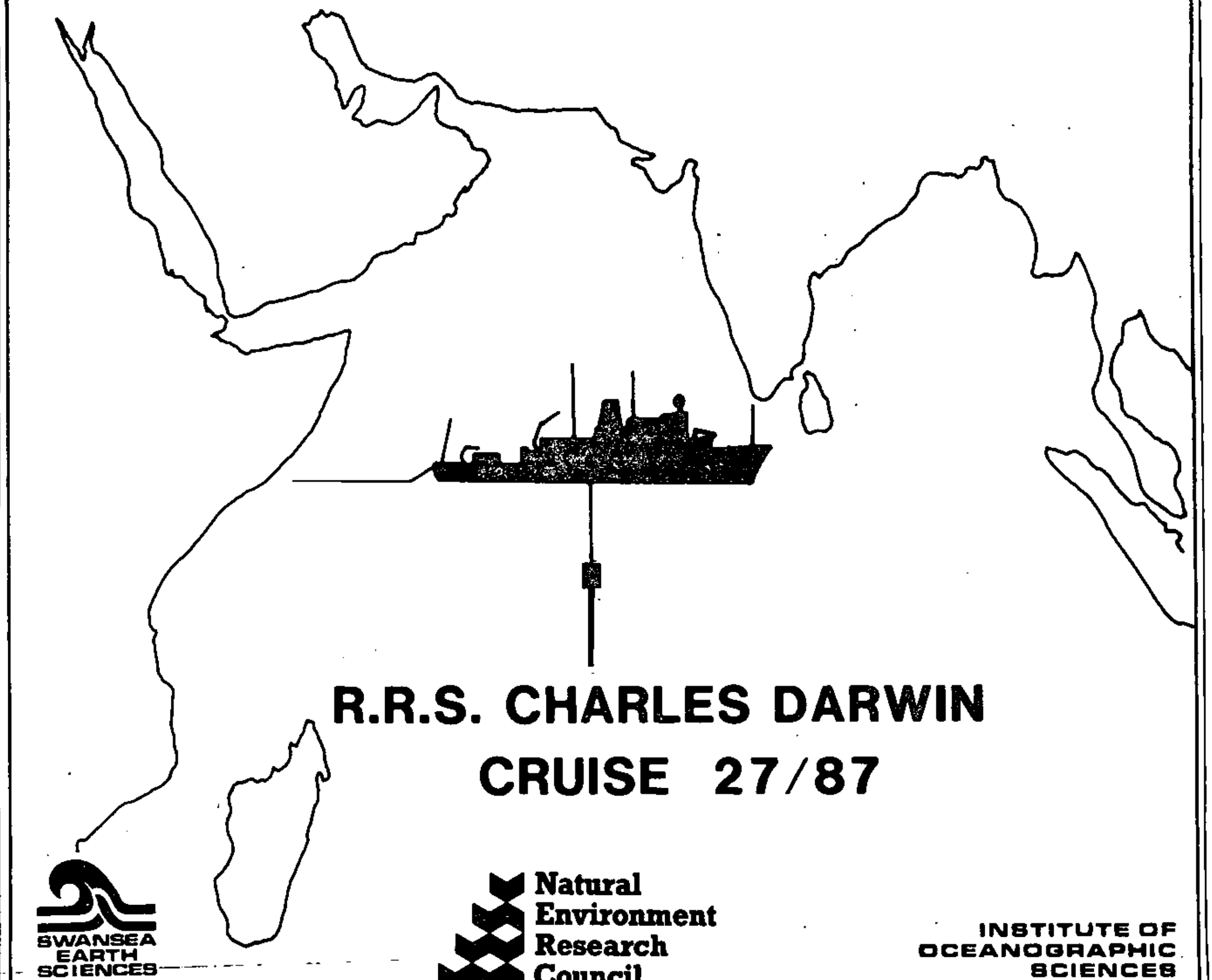

R.R.S. CHARLES DARWIN
CRUISE 27/87

SWANSEA EARTH SCIENCES

Natural Environment Research Council

INSTITUTE OF OCEANOGRAPHIC SCIENCES

DEPARTMENT OF EARTH SCIENCES, SWANSEA

INSTITUTE OF OCEANOGRAPHIC SCIENCES, WORMLEY.

R.R.S. CHARLES DARWIN.

CRUISE 27/87.

31st August - 24th September 1987.

SEDIMENTOLOGY OF THE INDUS SUBMARINE FAN.

Principal Scientist.

Adrian Cramp.

CONTENTS.

A. SHIPBOARD SCIENTIFIC GROUP.

Cramp, Adrian.	Earth Sciences Swansea (ESS) Principal Scientist.
Gunn, David.	Institute of Oceanographic Sciences (IOS).
Hine, Nicki.	IOS.
Inam, Asif.	National Institute of Oceanography Pakistan (NIOP) & ESS
James, Alec.	ESS.
Kenyon, Neil.	IOS.
Rasul, Najeeb.	NIOP & ESS.
Rothwell, Guy.	IOS.
Weaver, Phil.	IOS.

From Research Vessel Services (RVS), Barry.

Caruana, Vic.

Evans, Huw.

Jones, Doriel.

Paulson, Chris.

Phipps, Richard.

B. INTRODUCTION.

Cruise 27 of R.R.S Charles Darwin in September of this year saw the second shipboard and landbased joint venture between the Department of Earth Sciences, Swansea and the Institute of Oceanogrphic Sciences, Wormley. The programme involves the detailed geological investigation into the mapping and sedimentology of the mid Indus Submarine Fan (the world's second largest submarine fan that covers an area of approx. 1,250,000 km^2 of the floor of the Arabian Sea). In February 1987 Cruise 20 led by Dr Niel Kenyon of I.O.S. successfully mapped a section of the submarine fan using G.L.O.R.I.A. (Figure 1). Cruise 27 was to be the follow-up cruise, mapping selected areas in more detail using seismic methods and carry out intensive sediment sampling within these areas. We were particularly interested in the huge channels (up to 1km wide and 100m deep) that meander over the surface of the fan and look very similar to river floodplains on land. In the ancient sequences such channels would form likely resevoirs for oil and gas. In addition, we were also interested in determining what caused differing areas of backscattering (lighter/darker tones) on the G.L.O.R.I.A. mosaic. Initially the Cruise had two main scientific goals: the development of more sophisticated models of submarine fan development; and the ground-truthing of G.L.O.R.I.A. side-scan images in terms of sediment type.

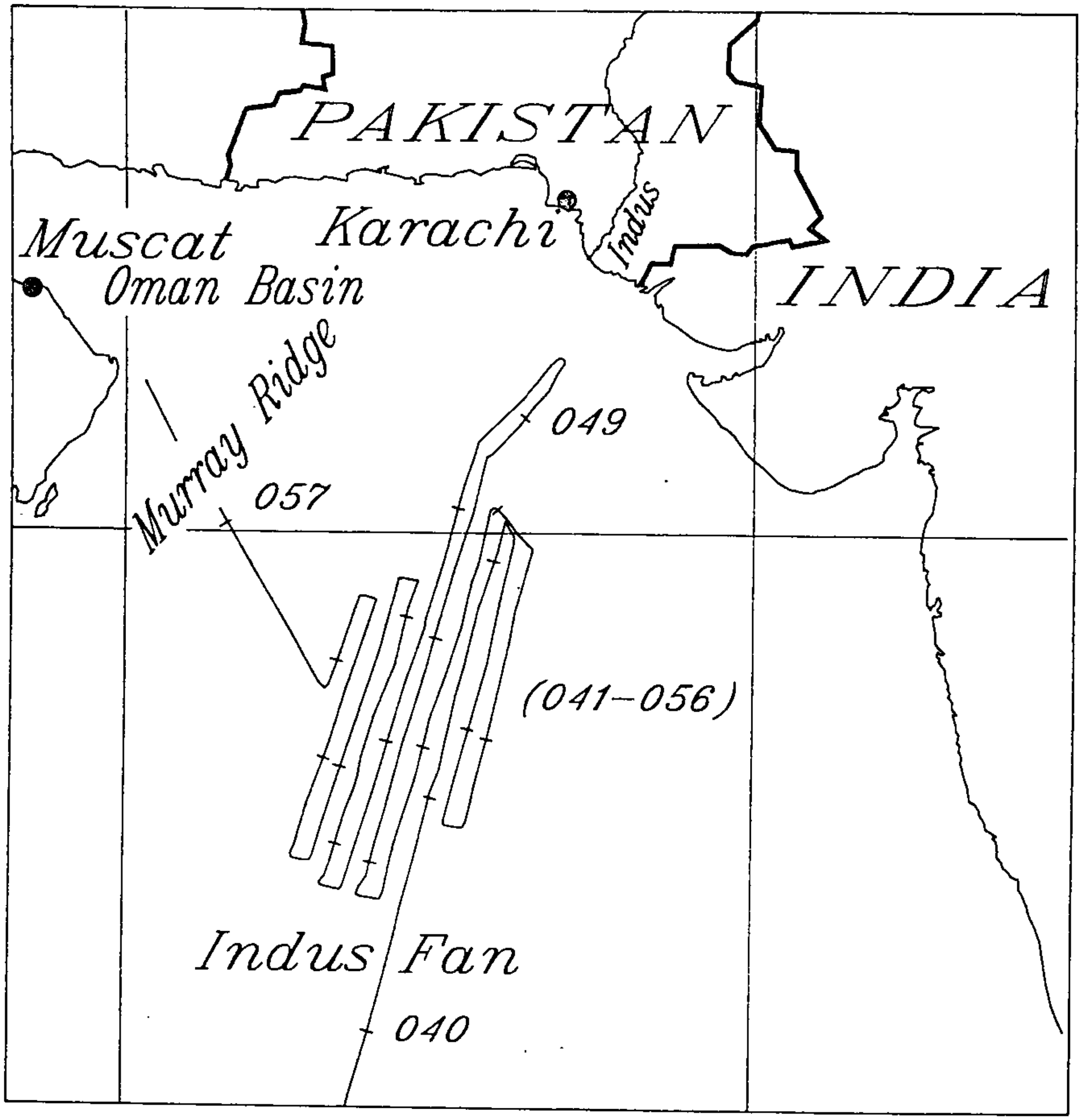

Figure 1. Track plots Cruise 20 R.R.S. Charles Darwin (Numbers indicate days). Figure reproduced by the kind permission of I.O.S. (Wormley).

C. NARRATIVE.

What follows is a brief daily log of Cruise 27/87. All times recorded are in GMT, days are Julian. The cruise ran from Minas Qaboos, Muscat (31-08-87, pm, Day 243) to Minas Qaboos, Muscat (24-09-87 am, Day 267).

Prior to the cruise, Oman granted permission to survey within their 12-200 mile limit. The cruise programme <u>did</u> <u>not</u> make provision to operate within either Pakistani or Indian territorial waters.

Lt Abdul Aziz Khan (Pakistani observer) failed to turn up before departing Minas Qaboos. We were notified whilst at sea that the two Pakistani scientists on board (Mr Asif Inam and Mr Najeeb Rasul, both members of the National Institute of Oceanography N.I.O., Pakistan) would represent Pakistani interests if we did intended to operate within Pakistani waters. The need never arose.

DAY 243 (31-08-87)

11.00 Pilot on board, depart Minas Qaboos, Muscat.
15.53 Deploy 3.5kHz system and hull mounted PES (outside 12 mile limit).
16.45 3.5kHz operational at 23 14 N, 59 23 E.
16.45 Passage to 19 17 N, 65 25 E on a bearing of 125° at 10kts.

DAY 244

08.12 Begin pass over Murray Ridge at south east edge of Oman Basin.
10.30 Completed pass over Murray Ridge.
14.43 Deploy single channel seismics at 2kts ($300''^3$ waveshape and hydrophone 2x50m active sections) at approximately 21 13 N, 62 39 E.
15.00 Deploy PES external fish.
15.10 Speed increased to 5kts.

16.10 Channel levee system on 3.5kHz
17.50 Deploy magnetometer, increase speed to 7kts.

DAY 245

Continue en route for 19 17 N, 65 25 E at 7kts.

17.30 Position 19 18.25 N, 65 23.34 E, over major relict channel - pass over point (19 17 N, 65 25 E) search for core site in pelagic sequences.
17.56 Alter course to 090 to run directly down levee to abyssal plain.
19.00 Seismics and maggi recovered.
21.12 On coring station (CD 27-1) 19 14 98 N, 65 32.67 E. Problems with coring gear. No grub screws supplied for piston barrel connectors, pilot core cutter rusted to barrel.
23.20 Piston corer overboard.

DAY 246

00.46 Piston corer on bottom (19 15.7 N, 65 31.2 E).
02.10 Piston corer on surface.
02.54 Piston corer on board, 8.06m sediment, trigger 1.0m sediment!.
03.28 Speed to 2.5kts to deploy seismics (160 waveshape) and maggi.
04.15 Position 19 15.5 N, 65 33.1 E seismics deployed - moving towards point A, 19 20.6 N, 66 37.2 E (Box A) at 4kts
05.15 Speed increased to 7kts.
22.46 End of site survey at point E Box A. (3 passes over main acive channel; run to point A with GPS B to C and D to E without). Recover seismics.

DAY 247

00.31 Proceeding to point A Box A for first Kasten core (CD-27-2).
03.26 Corer deployed.
04.40 Corer on bottom (19 20.0 N, 66 36.1 E, 3180m wire, 3160 water).
06.00 Corer recovered (3.5m sediment).
06.35 Passage to core site CD-27-3.
07.54 Core site CD-27-3 (19 20.1 N, 66 29.1 E).
08.00 Corer deployed.
10.38 Corer recovered (4m bent at 2m only 1.2m recovered).
11.42 Core site CD-27-4 (19 20.03 N, 66 25.35 E).
14.13 Corer on bottom.
16.00 Corer on deck (1.84m sediment)
17.00 Core site CD-27-5 (19 19.1 N, 66 20.6 E 3000m).
18.34 Corer on bottom (19 19.6 N, 66 20.1 E).
20.06 Corer on deck (2.8m sediment).
21.52 Core site CD-27-6 (19 19.2 N, 66 11.9 E 3090m).

DAY 248

00.29 Corer on deck (Core cutter sample plus 0.4m).
01.45 Core site CD-27-7, retake of CD-27-6 (19 18.4 N, 66 09.02 E, 3120m).

03.03 Corer on bottom (19 18.25 N, 66 08.4 E, 3185 wire, 3130 water).
04.11 Corer recovered (2m sediment).
04.12 Passage to main channel   for second attempt!
09.36 Core site CD-27-8 (19 19.4 N, 66 25.3E), corer on bottom (3020m water, 3010m wire!).
11.48 Corer recovered (1.94m sediment).
12.00 Proposed box core site. Broken lifting crane - abort box core site
12.13 Proceeding to position A Box B for site survey at 2kts.
12.30 Deploy seismics and maggi.
22.40 A/C to 240 , start line AB Box B.

DAY 249

06.48 Start line CD Box B.
Run site survey lines EF then GH

DAY 250

06.32 End point site survey box B (H), gear on board.
10.11 Box core CD-27-9 on bottom (18 54.56 N, 65 01.84 E, 3350m water).
11.40 CD-27-9 on deck - no sample.
12.15 Redeploy CD-27-9.
14.13 CD-27-9 on bottom (18 53.91 N, 65 00.78 E).
15.33 CD-27-9 on deck - sample (0.43m sediment).
15.48 Moving to CD-27-10 (Box core).
18.18 On station CD-27-10.

DAY 251

After 2 attempts to core at site CD-27-10......
03.40 CD-27-10 on bottom (18 40.7 N, 65 02.5 E 3390m).
05.16 CD-27-10 recovered (0.43m sediment).
05.30 Moving to CD-27-11 (Kasten core).
07.50 On station CD-27-11 (18 46.52 N, 65 13.78 E).
09.21 CD-27-11 on bottom (18 46.80 N, 65 13.71 E, 3373m water).
10.45 CD-27-11 on deck (0.77m sediment).
11.00 Moving to CD-27-12 (Box core).
12.11 Station CD-27-12 (18 45.25 N, 65 17.48 E).
14.20 CD-27-12 on bottom (18 44.19 N, 65 17.71 E, 3362m water).
20.00 Underway to camera deployment site.
23.29 W.A.S.P. in water.

DAY 252

01.30 Camera (W.A.S.P. system) start position (18 48.15 N, 65 19.56 E).
08.15 W.A.S.P. end point (18 44.48 N, 65 17.37 E).
09.56 W.A.S.P. on board.
10.02 Transit to CD-27-13 (Piston).
14.18 CD-27-13 core deployment.
15.40 Corer on bottom (18 43.8 N, 65 17.4 E, 3340m water).
18.04 Corer on deck (poor core-pre trigger?).

18.30 Moving N to redeploy CD-27-14.
19.40 Redeploy at station CD-27-14.
22.08 Corer on bottom (18 44.55 N, 65 16.45 E, 3345m water).

DAY 253

00.40 Corer on board - bent! approx 3m sample - fine sands.
02.30 On station CD-27-15 - at this stage problems were encountered rerigging the piston corer for redeployment.
04.32 Moving to regain original core station.
11.07 Corer on bottom (18 56.83 N, 65 14.55 E, 3273m water).
12.59 Corer recovered (no sample).
13.06 Transit to CD-27-16
18.30 On station CD-27-16 (Piston core).
20.58 Piston core on bottom (18 25.69N, 65 19.25E, 3355m water).
22.40 Corer recovered, (7.28m sediment).

DAY 254

00.06 Transit to CD-27-17.
00.48 On station CD-27-17.
01.10 Kasten corer deployed.
03.01 Corer on bottom (18 21.49N, 65 14.63E 3330m).
04.30 Corer recovered (2.67m sediment).
04.54 Transit to CD-27-18.
05.42 On station CD-27-18, Kasten corer.
08.22 On bottom (18 18.15N, 65 17.86E, 3317m water).
10.04 Corer recovered (2.20m sediment).
10.21 Transit to CD-27-19 (Kasten).
12.08 On station CD-27-19.
15.56 Corer on bottom (18 06.10N, 65 21.63E, 3370m water).
17.42 Corer recovered (2.82m sediment).
18.29 Transit to CD-27-20
19.45 On station CD-27-20 (Box).
22.34 Corer on bottom (18 16.1N, 65 26.2E, 3338m water).

DAY 255.

00.30 Corer on deck (0.46m sediment).
01.00 Transit to CD-27-21 (Box).
04.04 On station CD-27-21.
05.58 Corer on bottom (18 14.58N, 65 28.70E, 3316m water).
07.20 Corer on board, pressure release pin failed to shear.
08.27 Redeploy CD-27-21
10.23 Corer on bottom (18 12.45N, 65 26.69E, water depth 3316m).
11.36 Corer recovered, empty, main coring warp snagged on support frame of Calvert corer.
12.45 Deploy Kasten corer at station CD-27-21.
15.47 Corer on bottom (18 12.76N, 65 27.25E, 3316m water).
17.15 Corer recovered (0.50m sediment).
18.04 Transit to CD-27 22 (Piston).
20.00 On station CD-27-22.

DAY 256.

00.04 Corer on bottom (18 09.45N, 65 19.78E, 3365m water).
02.50 Corer on board, bent!(no sample).
03.10 Seismics deployed (160 ", maggi)
04.06 Seismics running - moving east across main active channel.
16.12 A/C to 256 from 176, eastern end of seismic run.

DAY 257.

05.45 End of seismic run, gear being recovered at approx. 17 33.57N, 65 08.20E.
06.32 Gear recovered transit to CD-27-23 (Piston).
07.00 On station.
11.36 Corer on bottom (17 28.09N, 65 09.27E, 3490 water, 3513m wire).
13.30 CD-27-23 recovered (4.05m sediment).
13.48 Transit to CD-27-24 (Piston).
15.54 On station CD-27-24.
18.10 Corer on bottom (17 31.18N, 65 08.31E, 3490m water).
20.10 Corer recovered (4.2m sediment).
20.54 On station CD-27-25 (Kasten).
22.54 Corer deployed.
23.12 Problems with coring warp wire

DAY 258.

01.25 Corer on bottom (17 32.14N, 65 07.16E, 3485m water, 3513m wire).
03.12 Corer recovered - empty - door failure.
04.00 Redeploy CD-27-25.
05.36 On bottom (17 31.46N, 65 07.62E, 3480m water, 3513 wire).
07.00 On deck - no sample.
07.45 Redeploy.
09.40 On botom.
11.15 On deck - no sample.
13.05 Redeploy.
15.18 On bottom.
17.10 On deck - no sample!
18.00 Redeploy!
20.37 On bottom (17 32.16N, 65 07.26E, 3480m water).
22.06 On deck - (catcher sample only).
22.57 Deploying maggi for run to cring station CD-27-26.
23.06 Start run.

DAY 259.

06.30 Recover maggi.
07.33 On station CD-27-26 (Piston).
09.59 Corer on bottom (17 35.42N, 65 27.97E, 3250m water).
11.41 Corer on board (7.96m sediment).
12.06 Deploy seismics (160 " airgun maggi) for run to Box C.

DAY 260.

08.50 A/C to 265.
12.54 Air gun failure - loss of records.
14.00 Air gun operating.

DAY 261.
07.06 Seismic run end point Box C.
07.48 On station CD-27-27 (Piston).
10.49 On bottom (15 29.43N, 63 15.04E, 3882 water).
12.50 Piston corer recovered (6.48m sediment).
13.06 Transit to CD-27-28 (Piston).
14.24 On station CD-27-28.
19.28 Corer on bottom (15 31.19N, 63 23.42E, 3868m water).
21.55 Corer recovered bent!(0.26m sediment)
23.18 Deploying box corer (CD-27-29).

DAY 262.

02.23 Box corer on bottom (15 30.08N, 63 22.73E, 3878m water).
04.32 Corer on deck (0.30m sediment).
07.19 On station CD-27-30 (Piston).
09.10 Corer on bottom.
11.08 Corer on deck - empty.
12.54 Redeploying CD-27-30.
14.43 Corer on bottom (15 31.49N, 63 23.04E, 3870m water).
17.15 Corer on board (0.94m sediment).
19.45 Deploying CD-27-31 (Kasten).
21.47 On bottom.
23.42 On deck (catcher sample only). empty.

DAY 263.

00.24 Prep for camera run 2.
01.24 Camera deployed.
02.30 Camera not operating.
03.00 Recovering camera.
07.40 Camera on deck.
07.50 Proceeding to CD-27-32.
09.48 On station CD-27-32 (Gravity).
11.48 Corer on bottom (15 30.48N, 63 22.97E 3870m).
13.45 Corer on deck (0.40m sediment!).
13.58 Transit to CD-27-33.
16.30 Maggi deployed.
18.48 Drag unmarked fishing nets - maggi recovered - 3.5kHz + PES fish inboard.
20.10 Switch to hull mounted PES transducer.
20.17 Underway.
20.58 Maggi deployed.

DAY 264.

03.02 Maggi recovered.
04.53 3.5kHz deployed moving to CD-27-33.

08.18 On station CD-27-33.
11.16 Corer on bottom (15 54.16N, 63 23.24E, 3650 water).
13.30 Corer on board (catcher sample only)
13.36 Underway to CD-27-34.
14.54 On station CD-27-34.
18.00 Corer on bottom (17 54.39N, 63 10.02E, 3665 water).
19.20 Corer on board (4.74m sediment)
19.40 Underway to CD-27-35.
22.48 On station CD-27-35.

DAY 265.

01.12 Corer on bottom (18 20.32N, 66 22.96E, 3610 water).
03.30 Corer recovered (2.50m sediment).
04.00 Maggi deployed - run to Muscat (3.5kHz + maggi).

DAY 266.

17.00 All gear recovered.

DAY 267.

09.00 Pilot on board docked Muscat.

D. EQUIPMENT - OPERATION AND RECOMMENDATIONS.

Sampling

A résumé of all stations and sampling operation is presented in Table 1. and illustrated in Figure 2. In all, 35 samples were obtained during the cruise.

(a) Piston Coring.

A total of 16 piston cores were obtained. In general, the piston coring system operated well, and this was in no small part due to the efforts of Huw Evans, Richard Fipps and Vic Caruana (R.V.S.), as were

Table 1. SAMPLING STATIONS CD 27

Station No.	Lat	Long	Op	L(m)	WD(m)
CD-27-1	19 15.75N	65 31.22E	P	8.0	3000
CD-27-2	19 20.63N	66 36.10E	K	3.5	3160
CD-27-3	19 20.16N	66 29.91E	K	1.2	2987
CD-27-4	19 20.57N	66 25.65E	K	1.45	2895
CD-27-5	19 27.62N	66 20.12E	K	2.9	3026
CD-27-6	19 19.28N	66 11.39E	K	0.4	3090
CD-27-7	19 18.75N	66 08.40E	K	1.93	3130
CD-27-8	19 19.47N	66 25.34E	K	2.10	3020
CD-27-9	18 53.91N	65 00.78E	B	0.43	3341
CD-27-10	18 40.83N	65 02.95E	B	0.43	3390
CD-27-11	18 46.80N	65 13.72E	K	0.8	3377
CD-27-12	18 44.87N	65 17.72E	B	0.55	3362
CD-27-13	18 43.80N	65 17.74E	P	3.66	3340
CD-27-14	18 44.55N	65 16.45E	P	2.70	3345
CD-27-15	18 56.83N	65 14.41E	P	-	3273
CD-27-16	18 25.69N	65 19.25E	P	7.28	3355
CD-27-17	18 21.49N	65 14.63E	K	2.67	3330
CD-27-18	18 18.15N	65 17.86E	K	2.20	3317
CD-27-19	18 06.10N	65 21.63E	K	2.82	3370
CD-27-20	18 16.10N	65 26.21E	B	0.46	3338
CD-27-21	18 12.76N	65 27.25E	K	0.50	3316
CD-27-22	18 09.45N	65 19.78E	P	-	3365
CD-27-23	17 28.09N	65 09.27E	P	4.05	3430
CD-27-24	17 31.18N	65 08.31E	P	4.20	3490
CD-27-25	17 32.16N	65 07.26E	K	cat.	3480
CD-27-26	17 35.42N	65 27.97E	P	7.96	3500
CD-27-27	15 29.43N	63 15.04E	P	6.48	3882
CD-27-28	15 31.19N	63 23.42E	P	0.26	3868

CD-27-29	15 30.08N	63 22.73E	B	0.30	3875
CD-27-30	15 31.50N	63 23.04E	P	0.94	3875
CD-27-31	15 30.36N	63 22.75E	K	cat	3870
CD-27-32	15 30.48N	63 22.97E	G	0.40	3870
CD-27-33	17 54.16N	63 23.45E	P	cat	3650
CD-27-34	17 54.39N	63 10.02E	P	4.74	3665
CD-27-35	18 20.32N	63 22.96E	P	2.50	3610

P-Piston Core
K-Kastenlot Core
B-Calvert Box Core
G-Gravity Core
cat- catcher sample only

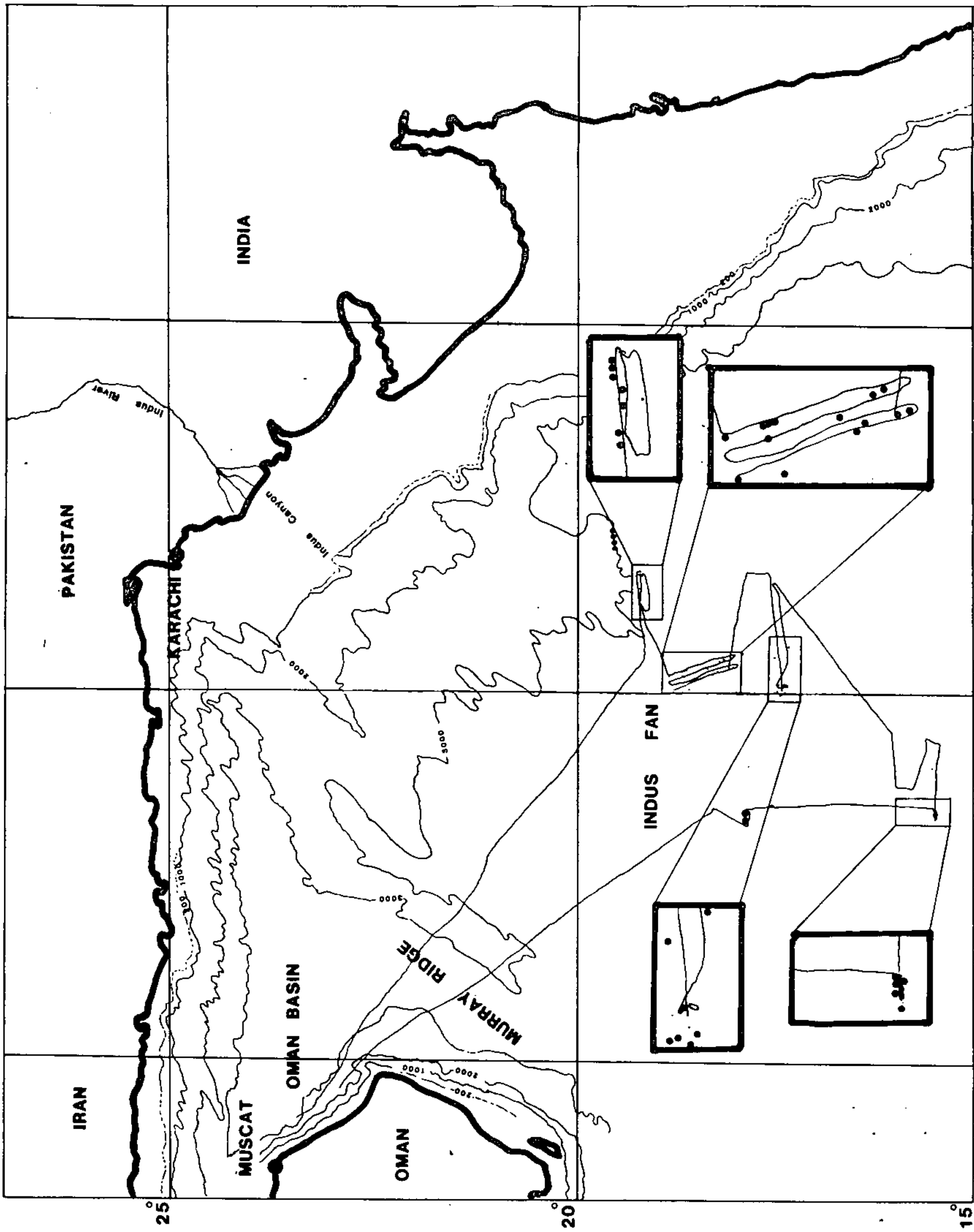

Figure 2. Track plot and sampling stations (black circles) Cruise 27. NE sector Box A, mid two boxes Area B SW sector Box C. For detailed locations of sampling sites see Table 1.

all coring operations. Towards the end of the cruise the piston coring system proved to be our most reliable piece of sediment sampling equipment, and was used frequently. With the aid of the 3.5kHz system, it was usually possible to 'drive' the coring system to suitable locations to enable good sample recovery however, on some occaisions the system was deployed in order to gain an insight into areas of medium and high reflectivity observed on the G.L.O.R.I.A. mosaic - in most of these areas sample recovery was small and in extreme instances core barrels bent.

The piston coring system on Charles Darwin should be improved to bring it into line with other European and American research vessels. Provision should be made to facilitate 5, 6 or more barrels on the starboard side during launching and recovery. This could be achieved, as the ship does have available freeboard, by the addition of 1 or 2 support davits. A hydraulic turning motor on the bomb bucket would aid deployment and recovery of the system.

Directly related to the piston coring operation - a study should be made on the pros and cons of Kevlar warp on N.E.R.C. research vessels.

(b) Kastenlot Coring.

A total of 14 Kastenlot cores were taken during the cruise. The Kastenlot corer is useful in that it provides a large volume of sediment, and tends to leave any sedimentary structures relatively undisturbed. It was for these reasons that the Kastenlot corer was used to obtain sediment from the areas within and around the channels (levee and channel).

The Kastenlot corer operated well until the third week of the cruise when a problem occured with the catcher doors on the system. This was eventually resolved, though the corer was not deployed again.

The system could be improved by the modification of some of the corers components.

(i) A simple method for securing the two halfs of the Kasten barrels should be designed. At present numerous small nuts and bolts secure the sections together, and have to be removed prior to sampling and post redeployment of the system.

(ii) Strengthening members should be added to the outsides of the barrels thus preventing bending. As a side issue to this, the welding of 2x2m barrels to achieve a 4m barrel is unsatisfactory. In all cases, the 4m barrels bent at or near the welded sections.

(iii) It should be noted that I.O.S. Kasten barrels are not compatible with the R.V.S. Kasten bomb - securing holes on the barrels do not line up with those of the bomb.

(c) Calvert Box Corer.

A total of 5 Calvert Box cores were taken on the cruise. The system was taken on the cruise in order to sample the sediment/water interface and provide undisturbed samples thus aiding in G.L.O.R.I.A. ground truthing.

The deployment success ratio was not good, and on reflection this was probably not the best system to take to sea for this purpose. In adition, the Calvert Corer owned by R.V.S. does need some modification. Sub sampling core samples from the sediment/water interface downwards requires the corer be dismantled completely - a procedure which can take up to 45 mins.

(d) Camera.

Despite many attempts by Dave Gunn (I.O.S) to get the camera system (W.A.S.P.) functioning efficiently, only one run was achieved at the begining of the cruise. Results from this run were encouraging, and it was hoped to deploy the system on at least two more occaisions. In the event, electrical failure aborted the second launch and a similar problem accounted for the failure of the third when time had been spent deploying the system to the sea floor.

In the light of other comments (pers comm. D. Gunn & Q Huggett I.O.S.) and the experiences of Cruise 27 the W.A.S.P. camera system should not be taken to sea again in its present state. The system should be completely rebuilt and/or redesigned. Deep tow camera facilities are essential to U.K. deep sea research. Research and development should be angled at the possibilities of deep tow video systems utilising the deep tow cable systems N.E.R.C. already owns (an idea which came from discussion at sea between I.O.S. R.V.S. and E.S.S).

Seismics.

Approximately 1,000 line km of single channel seismics was achieved during the cruise. This was aquired using either a 300$''^3$ or 160$''^3$ air gun and a 2x50m active section hydrophone. The system was used to provide a more detailed picture of our three main sampling areas and to complment the data aquired from Cruise 20 by running seismic lines en route between sites. Results obtained were good - much of this being due to the technical expertise of Chris Poulson (R.V.S.). In addition, the detailed site-survey data was recorded on the Racal Store 4 system provided on the ship. Play back of these records on board suggest that they will be suitable for processing at a later date.

Gravity.

The gravimeter was run throughout the duration of the cruise. Specific details to follow.

Magnetics.

The magnetometer was deployed along with the seismic gear, thus over 1,000 line km of manetics data were gatered during the cruise.

Computing Facilities.

On a cruise such as this, bearing in mind the limited satellite coverage in areas of the Indian Ocean, the ability to draw accurate track plots utilising the limited GPS and satellite data are essential. In addition, we needed to be able to locate areas and specific points on the G.L.O.R.I.A. mosaic obtained dring Cruise 20. This was achieved during the cruise thanks to the efforts of Doriel Jones (R.V.S.). This relatively simple computing facility proved essential to the success of the cruise.

E. INITIAL SCIENTIFIC RESULTS.

Despite some technical disappointments, Cruise 27/87 proved to be a great success. In a period of 23 days spent at sea, 35 seabed samples were obtained - this being the greatest number obtained to date from R.R.S. Charles Darwin. We also gathered over 1,000 line km of single channel seismic data. This data base will undoubtably provide the key to many of the unresolved problems regarding the sedimentology of the Indus Submarine Fan, in particular the age and distribution of the channel sequences, sedimentary processes across the fan and the overall morphology of the fan. This information will enable us to compare this system with others which exist today (c.f. Bengal, Amazon) and also draw comparisons with systems preserved in the ancient record.

At this stage the original scientific goals have only been briefly discussed with respect to the data obtained on the cruise.

Initial visual observations indicate that a number of factors influence the levels of reflectivity observed on the G.L.O.R.I.A. mosaic of the area.

It appears that the G.L.O.R.I.A. sonograph is a picture of the sediment type below the sediment/water inface (approx. 20-40cm below the surface). High and medium reflectivity areas observed on the sonograph (light and medium tones) being the result of impermeability of the G.L.O.R.I.A. signal and thus higher backscattering levels due to either increases in grain-size i.e. the transition from clays which tend to correlate with areas of low reflectivity on the mosaic compared to sands and silts producing an increase in the levels of backscattering. In addition the presence of a redox boundary (iron pan development) detected in the uppermost 40cm of the sediment in some areas could account for enhanced backscattering levels. On board geotechnical measurement (vane shear) also suggest a boundary in the sediment which could prove impenatrable to G.L.O.R.I.A. and thus account for areas of high backscattering.

All of these initial observations will have to be quantified and qualified before any specific conclusions can be drawn related to G.L.O.R.I.A. and the recognition of sediment type.

At this stage, little can be said of our second main scientific objective; the improvement of existing fan models. However, initial on board core logging (Guy Rothwell, I.O.S.) of sequences taken across the levee and channel system indicate sequences of fine-grained silty turbidites on the channel flanks. A horizon (up to 30cm in thickness) of foram ooze exists in many of the cores. A surface pelagic drape (up to 10cm in thickness) is present over much of the area. The relationship of these sequences to each other over the area will provide significant clues as to the contemporary and palaeo sedimentation processes in the area.

To date, none of the piston cores have been split. On repatriation in the U.K. these cores will be opened by Phil Weaver at I.O.S. It is hoped that by investigating the microfossil assemblages present, together with radiocarbon dating, the recored of channel abandonment across the fan may be determined. In addition, if coring has penetrated the last glaciation, significant palaeoclimatic and palaeoceanographic histories may be revealed.

F. SHIP ORGANISATION, OPERATION AND RECOMMENDATIONS.

It is a credit to all those concerned that the majority of N.E.R.C. research cruises achieve their scientific goals and in doing so observe the ever increasing and in most instances necessary safety requirements. This was certainly so for Cruise 27, and those who participated should be thanked for their efforts.

On a more serious note, it should also be recorded that if demarkation disputes and personality clashes continue to upset the day to day running of research ships, significant steps should be taken to resolve such problems. Confrontations such as these affect morale and confidence and if not resolved promptly can lead to an inefficient ship in terms of the gathering of scientific data and in extreme instances produce unsafe working conditions.

In terms of the efficient and safe running of the ship, a couple of recommendations came from Cruise 27.

(i) The provision of additional lighting on the starboard side and aft end. It was apparent during coring operations at night that the present lighting on board is ill placed and in some instances inadequate for coring operations of this kind. The lighting should be repositioned and in some instances additional lighting installed (this matter was raised at the shipboard safety meeting held on 13-09-87 and it was decided that R.V.S. technicians should recommend positioning for refit).

(ii) The disposal of plastic rubbish at sea on N.E.R.C. ships needs a rethink. I believe the dumpling of plastic rubbish at sea is illegal, yet despite attemts to rectify the situation the majority of catering and domestic plastic was dumped at sea (some scientific plastic was burnt after complaints by the scientific staff). This does seem strange given that facilities are available for burning this kind of rubbish on board.

(iii) The provision of exercise facilities (mobile rowing and bicycle machines) on board is needed. These need not be installed in a permanent position, in fact, mobility would be of use considering the limited space on board. These facilities should be available to all on board ship.

G. ACKNOWLEDGEMENTS.

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Dr Adrian Cramp

A. Cramp

P.S.O. Cruise 27

12th October,1987