Institute of
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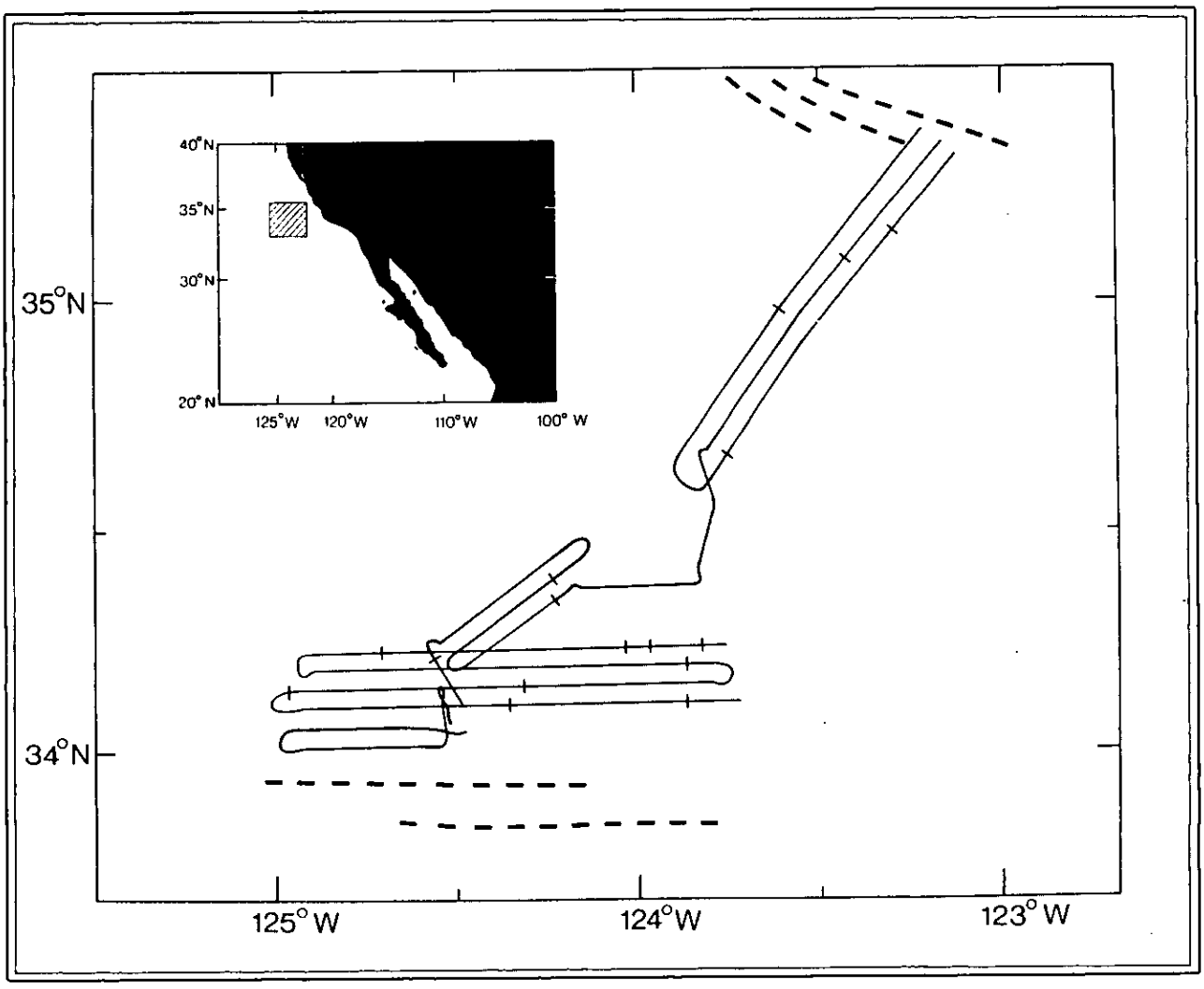
MV Farnella Cruise 6/90

19 Jun - 13 Jul 1990

TOBI Surveys of Monterey Fan

Cruise Report No 226 1991



Natural Environment Research Council

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CRUISE REPORT NO. 226

MV FARNELLA CRUISE 6/90
19 JUN-13 JUL 1990

TOBI surveys of Monterey Fan

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ABSTRACT

The main objective of the cruise was to collect TOBI deep-towed 30kHz sidescan sonar and 7kHz profile data from the depositional lobe of the Monterey Fan, off southern California. The area had previously been chosen for GLORIA 'groundtruth' studies, and had been the site of intensive coring programmes in 1987, 1988 and 1989. A large amount of 3.5kHz profile data and several camera stations also existed in the area prior to the cruise. M. V. Farnella departed from Redwood City at 0930 (local time) on the 19th June and docked at 0900 on the 13th July. This was an extremely successful cruise during which 1100 line kilometres of TOBI sidescan data were collected, giving an areal coverage of some 6000 km^2. Spectacular sidescan sonar images were obtained from a variety of fan environments ranging from the channelled terrain of the mid-fan to the interfingering turbidite/abyssal hill terrain of the lowermost fan.

KEYWORDS

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ISSUING ORGANISATION

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ITINERARY

Depart Redwood City, 19th June, 1990

Arrive Redwood City, 13th July, 1990

CRUISE OBJECTIVES

The main objective of the cruise was to collect TOBI deep-towed 30kHz sidescan sonar and 7kHz profile data from the depositional lobe of the Monterey Fan, off southern California. The area had previously been chosen for GLORIA 'groundtruth' studies and had been the site of intensive coring programmes in 1987, 1988 and 1989. A large amount of 3.5kHz profile data and several camera stations also existed in the area prior to the cruise. However, detailed correlations between GLORIA, profile and core data had proved difficult to establish, at least partly through problems of scale, and it was hoped that the intermediate scale and higher resolution of the TOBI sidescan instrument might assist in solving this problem.

If time permitted, it was also planned that TOBI data would be collected over parts of the Monterey Fan channel and over the distal part of the Sur Slide, a large debris flow on the upper fan. Box and piston corers were carried on the cruise so that, if required, targets seen on the TOBI mosaics could be sampled. However, coring was seen primarily as a back-up operation, which would only become important if the TOBI system experienced significant down-time.

CRUISE NARRATIVE

M. V. Farnella departed from Redwood City at 1630GMT (0930 local time) on the 19th June (Julian Day 170). A course was set for an area of deep (>3000m) water west of Monterey Bay, so that tests on the winch could be run. One extra mechanical technician was embarked to assist with these tests, with the intention that he should be landed after 2 or 3 days if the winch worked satisfactorily. Two extra navigation personnel were also embarked for this initial 2 to 3-day period to complete the preparation of the acoustic navigation system. Winch tests started at 0100/171, and the TOBI depressor weight and an acoustic transponder were launched at 0200. Tests were completed by 0900/171, and although the spooling gear could not be made to work, it was decided that it was possible to operate the winch without it. Since the acoustic

navigation was now functioning, a course was set for a point off Santa Cruz to disembark the three extra technical staff. This was completed by 2230/171 and a course was set for 34° 10'N, 124° 06'W, the point where the first transponder of the acoustic net was to be laid.

This first waypoint was reached at 1300/172, and the 3.5 and 10kHz fishes were deployed. The deployment of the acoustic navigation transponders had to await good GPS coverage, and began at 1800/172 when the first transponder was laid at 34° 10'N, 124° 06.22'W. Transponder deployments continued throughout the next 8 hours (Table 1). A problem was immediately apparent with transponders 1 and 2, which could only be received at very short ranges. However, all the other transponders appeared to be working perfectly. It was decided that the surveying-in of the transponder net should continue overnight, and that the faulty transponders would be recovered in the morning. Surveying of the transponder net was therefore begun at 0400/173, shortly after the last transponder to be launched had reached the seabed, and was completed by 1300. We then returned to transponder 1, which by this time was giving only a weak intermittent signal. The release code was sent out several times beginning at 1430, and although no acknowledgement was received, it soon became obvious that the transponder was coming up. It surfaced at 1542 and was recovered without incident. We then steamed to the location of transponder 2, where we had decided to replace the second faulty transponder. A new transponder (No.7) was deployed at 1714/173 and transponder 2 was then released. It surfaced at 1845 and was recovered without incident. Survey of the new transponder was carried out between 1900 and 2100/173, after which course was set for the first TOBI deployment point.

The first TOBI deployment began at 0100/174 at 34° 14.4'N, 123° 46.0'W. With calm weather and the large amount of deckspace available on the Farnella, the launch went smoothly and by 0200 deployment was complete. However, at 0245 the power supply to the vehicle failed when the profiler was switched on. It was obviously necessary to recover the vehicle and this was completed by 0400. The problem was traced to a faulty connector on one of the electronics pressure tubes. This was replaced and TOBI was relaunched between 1700 and 1815/174. Wire was paid out slowly, because of uncertainties in the winch performance, but operational depth was achieved by 2210. Excellent data was collected until 0225/175 when all signals from the vehicle stopped. Recovery of TOBI began at 0250 and the vehicle was safely on deck by 0645. The fault was traced to the brushes in the slip-ring of the depressor weight, which had

burned out, although no obvious cause, such as water leaking into the housing, was apparent. Again the system was rebuilt overnight and was relaunched between 1700 and 1800/175. Survey depth was reached at 2100/175. Between this time and 1930/182 four 100km long east-west survey lines were run across the distal part of the depositional lobe of Monterey Fan.

The towing depth of the vehicle was controlled during the survey by slight variations in ship's speed, rather than by using the winch, since use of the winch required two men on deck at all times. To allow maximum flexibility during the turns at the end of each line no attempt was made to keep TOBI at surveying depth when turning. Instead, wire was recovered until the wire out was some 200m less than the water depth so that the ship could turn rapidly (up to 10°/5 mins) with no possibility of the vehicle colliding with the seabed. This strategy was effective in allowing TOBI to be placed accurately at the start of each survey line with a minimum of difficulty. Recovery of TOBI began at 1930/182. The vehicle reached the surface at 2215/182 and was secured onboard by 2300. The acoustic navigation fish and the bowthruster were then secured and passage was made to the nearest acoustic transponder to begin recovery of the acoustic navigation net. Recovery of the transponders began at 0130/183 and was completed without trouble by 0800.

We then steamed to the start point of the next TOBI survey area at 34° 03.5'N, 124° 28.6'W where TOBI was deployed between 1500 and 1600/183. Some two hours were then taken up in testing the TOBI compass, after which the deployment of the vehicle to its operating depth began. This was reached at 2000/183. Between this time and 0330/185 the earlier survey of the south-western part of the Monterey Fan lobe was extended to the south, towards the Murray Fracture Zone. This survey was completed by 0330 and we turned toward the north, across our earlier survey, to see whether the TOBI sidescan record varied with insonification direction. However the TOBI profiler became progressively more noisy between 0200 and 0630/185, culminating in a vehicle power failure at 0630. TOBI was therefore recovered at 1000/185 following which a break in the lead between the umbilical and the depressor weight was diagnosed. This was repaired overnight and the vehicle was redeployed by 1630/185. Logging began at 2000 when the survey depth was reached.

For the next three days we continued our survey up the fan, first examining a broad sediment pathway between two seamount provinces and then moving eastward to

survey the northern flank of a large seamount. We then began to follow towards the north the fan channel which appears to have been most recently active. This survey occupied the remainder of our time, ending at 2000/193. TOBI was recovered and secured on deck by 2300/193 when we began our transit back to Redwood City. Farnella docked at 1600/194 (0900 local).

DGM

TOBI OPERATIONS

The TOBI system performed well above expectations, particularly since this was its first fully operational cruise. Four deployments totalling 17 operational days were completed. The longest deployment was exactly 8 days in length. Three system failures gave rise to less than 2 days downtime during the cruise; much of this downtime was accounted for by the time taken to recover and re-launch the vehicle. Two of the system failures were traced to trivial problems with a connector and a power lead. The third, however, was the result of the burning out of the slip-rings at the bottom end of the tow-cable in the depressor weight. This problem, which also occurred on the earlier trials cruise, seems to result from gradual oxidation of the oil in the slip-ring housing, which eventually leads to the shorting out of the slip-rings due to a build-up of carbon in the oil. For the remainder of this cruise the problem was controlled by changing the oil between deployments. In the long-term, however, it would seem that some re-design of the slip-rings is required.

RESULTS

This was an extremely successful cruise during which 1100 line kilometres of TOBI sidescan data were collected, giving an areal coverage of some 6000 km^2. Spectacular sidescan sonar images were obtained from a variety of fan environments ranging from the channelled terrain of the mid-fan to the interfingering turbidite/abyssal hill terrain of the lowermost fan. The more important preliminary results of the cruise are as follows:

1. Previous studies in part of the TOBI study area ('the fingers area') had attempted, with little success, to establish a correlation between distinctive patterns of GLORIA backscattering and sediment lithology as seen in a series of short (60cm) box

cores. The most likely reasons for the lack of correlation were believed to be either a problem of scale in correlating box cores with GLORIA pixels or a problem of penetration, with GLORIA imaging features deeper than the limited box-core penetration. It was hoped that the much greater resolution of TOBI would allow greater possibilities of correlation by providing a link at an intermediate scale. In practice, the strong backscatter contrasts seen by GLORIA in the fingers area were not seen by TOBI. This almost certainly confirms the GLORIA penetration theory, since it appears that the higher frequency TOBI sidescan sonar is also failing to reach the targets which are generating the GLORIA backscatter contrasts.

2. In its most distal area the Monterey Fan is infilling a rough topography of abyssal hills and fracture-zone ridges. This gives rise to interfingering turbidites which infill the valleys and pelagic drape which covers the ridges. The TOBI sidescan sonar and profiler proved ideal for differentiating the two facies. Erosion of the valley floors and walls caused by the passage of turbidity currents is apparently widespread, the resulting undercutting causing large blocks of pelagic sediment to slide into the valleys. Overall, erosion on the lower fan proved much more widespread than anticipated, highlighting the importance of the continually lower base-levels reached by the fan as it advances seaward.

3. The survey of the distal part of the Monterey Fan channel, immediately south of the Morro Fracture Zone, produced the most spectacular images of the cruise. Terraces, meanders and sediment bedforms associated with the channel are seen in superb detail. Most unexpectedly, a number of erosional channels are seen cutting into the levee associated with the main channel . These begin as areas of 'badland' topography on the very low gradient ($< 1^{\circ}$) levees. Extensive bedform fields, with bedforms orientated perpendicular to the main channel but parallel to the regional slope, are also seen on the levees. Overall, we believe that these observations suggest that very large non-channelised turbidity currents may be most important in shaping the sedimentary environment of this part of the fan.

Table 1. Location of acoustic navigation transponders.

Transponder	Latitude	Longitude	Water Depth (m)	Deploy Time
2*	34° 09.99'	124° 06.22'	4442	1801/172
4	34° 11.87'	124° 07.43'	4443	1918/172
5	34° 09.98'	124° 08.83'	4450	2009/172
6	34° 11.87'	124° 09.91'	4450	2328/172
3	34° 10.00'	124° 11.28'	4455	0018/173
1*	34° 11.88'	124° 12.47'	4456	0133/173
7	34° 10.07'	124° 05.94'	4441	1714/173

* Transponder malfunctioned

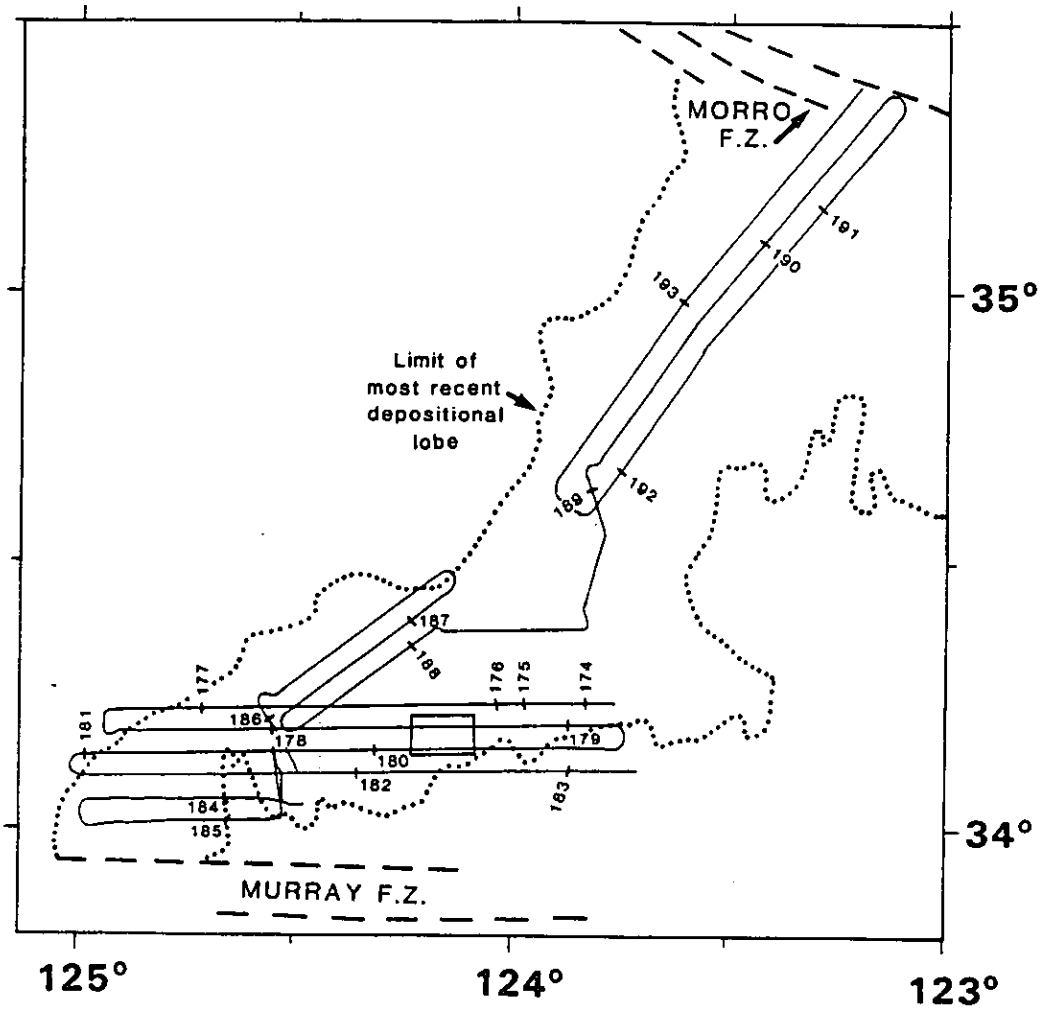

Figure 1. TOBI survey tracks occupied during cruise M. V. Farnella 6/90, 19 Jun - 13 Jul 1990. Day numbers show position at 0000 hrs. Box at 34° 10'N, 124° 10'W shows location of transponder net (Table 1). Dotted line is the limit of the most recent depositional lobe of the Monterey Fan.