I.O.S.

R. R. S. DISCOVERY

CRUISE 88

23 October - 16 November, 1977

Geochemical studies off the Iberian Peninsular and Biological sampling in the Porcupine Sea Bight area

CRUISE REPORT No. 65

1977

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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Depart Gibraltar 0730 23 October 1977

Arrive Barry 2030 16 November 1977

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J.D. Burnham	I.O.S.
D. Burton	University of Southampton
S.E. Calvert	I.O.S.
E. Darlington	I.O.S.
A.J. Gooday	I.O.S.
Miss C. Green	I.O.S.
M.J. McCartney	I.O. .
C.I. Measures	University of Southampton
N.R. Merrett	I.O.S.
J. Neilsen	Zoological Museum, Copenhagen
R.D. Peters	I.O.S.
Miss E. Reid	University of Southampton
A.L. Rice	I.O.S. (Principal Scientist)
Miss H. Rowson	University of Liverpool
M.H. Thurston	I.O.S.
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T.R.S. Wilson	I.O.S.
G. Yarwood	I.O.S.

SHIP'S OFFICERS

M.A. Harding	Master
P. MacDermott	Chief Officer
S. Jones	2nd Officer
N.C. Jonas	3rd Officer
A. Lennox	Chief Engineer
P. Stone	2nd Engineer
C. Phillips	3rd Engineer
C. Harman	4th Engineer
R. Thomas	5th Engineer
T. Harris	Radio Officer
L. Wilson	Electrician
R.M. Cridland	Catering Officer

OBJECTIVES

1. The collection of sediment samples, by conventional gravity coring and by box coring, for studies of the geochemistry and the meiofaunal content of Recent sediments.

2. The collections of samples of suspended particulate material from large volume bottles for geochemical studies.

3. The collection and analysis of water samples for the abundance of dissolved selenium.

4. The collection of aerosol samples by conventional mesh sampling and by membrane filtration.

5. Replicate sampling of sedimen pore water by in situ samples and shipboard-squeezed box-core samples for comparison of experimental techniques of pore-water sampling.

6. The occupation of a series of in situ pore water sampler stations in the various sedimentary environments within the cruise area of work.

7. Extensive biological sampling near the mouth of the Porcupine Sea Bight, including benthic samples from an epibenthic sledge and semi-balloon otter-trawl, and mid-water samples from all horizons between the bottom and the surface using the combination net.

8. To test a new acoustically operated "pop-up" fish trap.

SUBSIDIARY OBJECTIVES

1. The collection of large volume water samples for studies of the distribution of the lantharides (Leeds University).

2. The collection of water samples for the analysis of the abundance of dissolved iodine (Institute of Hydrology).

3. The collection of benthic organisms for studies of the distribution and organic associations of trace metals (I.O.S.).

4. Trials of magnesium/nickel corrodable links using the fish trap.

NARRATIVE

Discovery sailed from Gibraltar at 0730/23 October 1977. An expected Portuguese observer failed to appear before the ship sailed, rendering unnecessary the planned visit to Lisbon where he was to have disembarked.

After clearing the Straits a westerly course was set for a series of stations on the continental slope and rise leading to the Horseshoe Abyssal Plain. Six geochemistry and chemistry stations were worked on this transect, at depths of about 1300, 2500, 3500, 4300 and 4500m, the last being in the eastern basin of the

Plain itself. Various combinations of hydrocasts, gravity and box cores, and pore-water samples were taken at these stations and some time was lost in repeating unsuccessful casts. An intended station in the central part of the Plain was consequently not occupied and we proceeded direct to station 9629 in the western basin which was worked from 2200/26 to 1500/28. Replicate pore-water samples, box cores, gravity cores and hydrocasts were obtained at this station, mainly between deployment and recovery of the "pop-up" fish trap which was in position on the sea-bed for 24 hours. The trap worked well, but some time was lost during its recovery in the early hours of 28/10 by the P.S. chasing Discovery's own VHF signal with the RDF in the belief that the trap had already surfaced. This belief seemed to be confirmed when firing the acoustic release at 0230 elicited no obvious response. The appearance of a bottom echo along with the pinger trace two hours later (0426), however, signalled the departure of the trap from the bottom and cut short the tail-chasing exercise.

Upon completion of station 9629 Discovery made for a station on the slope off the Portuguese coast to the south west of Setubal to begin a transect across the Tagus Abyssal Plain and into the southern Iberian Abyssal Plain. Combinations of hydrocasts, pore-water samples, box cores and gravity cores were again worked at these stations, concentrating on the most westerly one at about 38°15'N, 17°34'W (9635). This station was intended to be in a depth exceeding 6000m where a red clay sediment might be encountered. Two small areas of such deep water are charted in this general region but we were unable to locate either of them and therefore settled for a somewhat shallower depth of about 5800m.

During a hydrocast at this station a Niskin water bottle and a pinger were both lost when the bottle collided with the block, at least partly due to a badly worn and therefore ineffectual brake lining on the steam winch. This station was a particularly unfortunate one, considerable time being lost due to pre-tripping of water bottles, malfunctions of the box-corer no-load release and problems with the pore-water sampler hydraulics. By the time the station was completed at 0700/3 it was clear, therefore, that the next intended one, at about 41°W, would have to be sacrificed. We made instead for the final geochemistry station in the northern Iberian Abyssal Plain at 42°20'N; 14°20'W in a depth of some 5300m. This station was completed at 2400/4 after successful hydrocast, box-core and pore-water samples had been obtained, though no core was retrieved with the gravity corer.

Up to this point the weather had been very good, with winds not exceeding 20 kts since we left Gibraltar. As we steamed north towards the intended site of the

biological work in the month of the Porcupine Bight, however, the generally SW wind increased steadily to 30-35 kts, gusting to 40 kts, by mid-afternoon on November 6th. By 2100, when we reached the proposed station at about 49°N, 14°W, there was a heavy swell and it was clear that we would be unable to work any gear until the weather moderated. An echo-sounding run was therefore undertaken across the continental slope to the northeast. As indicated on the available chart, trawlable ground was found up to a depth of about 3500m, but thereafter the rate of rise was too rapid and the topography too irregular for benthic net work even at the shallowest end of the run at about 49°59'N; 13°84'W in 2600m. During the survey the weather slowly moderated and by the time the ship returned to the 4000m station at 0900/7 the wind speed had fallen to 20-25 kts and a CTD cast and wire test of the fish trap acoustic release was successfully completed. However, during this cast the wind freshened once more to well over 30 kts and any net work was again out of the question. An attempt was now made to survey a more northerly transect into the bight and a number of courses, mostly very uncomfortable, were attempted towards the north-east until finally, by 0330/8 the survey was abandoned and the ship was hove to. During the afternoon of the 8th the wind speed decreased to 20-25 kts and the ship returned once more to the 4000m station. The fish trap was deployed for a second time at about 1900/8, reaching the bottom and being fairly accurately fixed by 2200h. This was followed by an otter trawl haul, but during the haul the wind speed again increased, gusting to well over 40 kts, so that the recovery of the net at 0900/9 was quite difficult. The catch was excellent, but the vibration to which the gear had been subjected had loosened the bolts on the pinger bracket and resulted in the loss of the beacon. Net work again being impossible, and the forecast being very unpleasant, the ship was again hove to throughout the 9th, 10th and 11th, during which time the wind was fairly consistently between 35 and 55 kts, but gusting at times to 65 kts.

During the early hours of the 12th the weather showed some improvement in that the wind speed fell to 30/35 kts and an attempt was made to recover the fish trap. However, though the acoustic release was apparently operated successfully several times during the forenoon, the trap had shown no sign of leaving the bottom by 1400 h. Since the back-up timer release on the trap was not due to operate until about 2100/12 a second CTD cast was made in the meantime and was completed by 1730 h. The fish trap location was now revisited but there was still no indication that it had left the bottom by 2300 hrs. At this time the weather was sufficiently good to shoot the otter trawl for a second time and although the

wind speed once again increased during the haul the net was successfully landed without too much difficulty at 1000/13. Since the weather was by now clearly too bad to allow any other gear to be worked the ship was hove to once more awaiting an expected improvement. By early afternoon this improvement seemed to have materialised and the final preparations of the epibenthic sledge were begun. These preparations were fortunately delayed by camera system problems, for by 1600 h the wind had once more freshened and while it might still have been possible to shoot the gear it would have been difficult to land it safely, particularly as a further increase in wind speed was forecast.

After once more listening to the fish trap pinger, and finding that it was still on the bottom, it was switched off and we steamed to the north-east to attempt a further otter trawl in rather shallower water. At 2200 h, in a sounding of about 3500m, the trawl was shot in a wind speed of about 30 kts. By 0100/14 the wind had increased to 35/40 kts and since it was expected to freshen still further the haul was abandoned. By the time the net was landed at 0330 h the wind speed was between 40 and 50 kts. These strong winds persisted until noon/14 and in view of the very bad forecasts received no further work within the time remaining could be contemplated. At 1400/14, therefore, Discovery left the work area for Barry where she docked at 20.30/16.

REPORTS OF PROJECTS

BIOLOGY

PROTOTYPE FREE FALL FISH TRAP

A free fall fish trap of novel design was laid in two positions. On the first occasion, baited with squid, it was dropped to 4850m and left for 26 hours. After this period it was located and the acoustic release operated. It did not break free from its anchor weights, however, till almost 2 hrs later. It was tracked acoustically to the surface and located close to the ship in good weather. It was recovered without difficulty and found to contain a single, very large synaphobranchid eel, apart from several hundred amphipods on the bait. Shipboard development of the film taken by the in situ camera indicated that at least one other fish had visited the trap, but had escaped. The film also monitored the changes in heading of the trap during the period it was breaking free from the sea bed, from the compass attached to the floor of the trap. In the second locality the trap was laid in 3930m. It was released at night in worsening weather

conditions, but without difficulty. The intention was for it to be recovered after the 50 hour duration of the camera film had elapsed. Adverse weather prevented the possibility of recovery until the trap had been down for 4 days. At this first opportunity the trap was located and the acoustic release operated without difficulty. Repeated operations of this release, however, did not initiate lift off from the sea bed during the 13 hour period before the timed release was due to operate. Unfortunately this again failed to bring the trap to the surface. During the following 2 days the site was revisited on several occasions, but each time the trap was found remaining on the sea floor with the acoustics operating normally. When leaving the area the latter was finally turned off and the trap reluctantly abandoned.

SEMI BALLOON OTTER TRAWL

Two successful operations of the trawl were made in adverse weather conditions of 30-40 knot winds. A third operation had to be aborted when the wind speed steadily exceeded 40 knots, before the trawl had reached the bottom.

FISH

The single synaphobranchid eel caught in the fish trap was an exceptionally large (137 cm) gravid female Histiobranchus sp. The two trawl tows made in around 4000m and 3700m at the northerly position collected a surprisingly large quantity of fish. At the deeper station 37.5kg of fish were caught, comprised mainly of the macrourid, Nematonurus armatus. A number of small Chalinura (? leptolepis) and one synaphobranchid eel, Ilyophis, were also caught. One hundred and twenty fish were taken at the shallower station with a total weight of 89 kg. Again these were dominated by N. armatus, but the catch contained a much greater diversity than at the 4000m position. Of particular interest was an exceptionally large alepocephalid (8.6 kg), preliminarily identified as Enriara salmonea, and 9 specimens of the rare alepocephalid, Rinoctes nasutus. Also collected were several specimens of the rattails Chalinura and Lionuru, together with Bathysaurus mollis, Notocanthus sp. and Ilyophis brunneus.

N.R. Merrett

DECAPOD CRUSTACEANS

The two trawl catches contained nothing particularly unusual amongst the decapods. However, the number of Munidopsis, polychelids, and pagurids was high considering the depth and indicated a rich decapod fauna compared with hauls made in similar depths off the north-west African coast.

A.L. Rice

AMPHIPOD CRUSTACEANS

As has been found in the past, the OTSB 14 is not a suitable net for catching amphipods. The two hauls completed during the cruise produced only a few specimens, mostly hyperiids, from deep water. The single successful trap-set produced over 600 gammarids, however. Seven species, all belonging to the Lysianassidae, have been distinguished. Species of Paralicella, Orchomene and Eurythenes were numerically abundant, and form an interesting comparison with recently reported trap catches from the North Pacific gyre.

M.H. Thurston

ECHINODERMATA

Despite only minor geographic and bathymetric differences between stations 9638#2 and 9640, the echinoderm catches at the two stations were very distinct. This was particularly true of the Holothurioidea and Asteroidea.

Holothuroidea

Station 9638#2 was dominated by Psychropotes longicauda, Oneirophanta mutabilis mutabilis, Achlyonice ecalcarea and Molpadia blakei. Of these, P. longicauda was the only one to occur at Station 9640, though in smaller numbers. Station 9640 was dominated by Benthothuria, some specimens being as large as 30cm x 15cm x 20cm and very difficult to preserve. Variation in the size and shape of the dorsal appendage of P. longicauda occurred and O. mutabilis mutabilis was notable for a green pigment on the inner surface of the tentacles. Some specimens were frozen for trace metal and gut content analyses.

Asteroidea

Station 9638#2 was dominated by the Brisingid Freyella spinosa, which occurred with a few specimens of Dytaster and Paragonaster. F. spinosa, however, was absent from Station 9640 where the dominant asteroid was Dytaster sp. together with Zoroaster.

The Echinothuriidae were the only echinoids to occur and were far more common at Station 9640 as were the ophiuroids and crinoids.

D.S.M. Billett

WHALE OBSERVATIONS

Cetacea were recorded on fifteen occasions during the cruise. Nine of these records were of Delphinus dolphis. The remaining six records included the sighting of what was probably a pod of sperm whale (Physeter catodon) at 38°N 16°W. The relatively few sightings made during the latter part of the cruise may be attributable to the extended periods of bad weather experienced.

N.R. Merrett
M.H. Thurston

ORNITHOLOGY

Ornithological observations were made routinely as and when other duties permitted. In all about 180 watches were undertaken and 70 more casual records noted.

Seventeen species of sea birds were recorded. During the first part of the cruise, south of lat. 40°N, the off-shore decrease in numbers of species and individuals was very marked. At distances greater than 200 km off-shore birds were very few and far between, Greater and Sooty shearwaters (Puffinus gravis and and P. griseus), Leach's and British stormpetrels (Oceanodroma leucorhoa and Hydrobates pelagicus), Gannets (Moris bassanus), Great and Pomarine skuas (Catharacta skua and Stercorarius pomarinus) and lesser black-backed gulls (Larus

fuscus) being recorded in small numbers on relatively few occasions. During this part of the cruise N.E. winds were experienced and ten species of land birds were seen on the ship at various times.

North of lat. 40°N the avifauna was restricted in terms of species, but the number of individuals was higher, consequently observation periods without positive records were rare. Fulmar (Fulmarus glacialis) and Kittiwake (Rissa tridactyla) were seen regularly with smaller numbers of Greater shearwater and Great skua.

M.H. Thurston

CHEMISTRY

HYDROGRAPHIC WORK

The hydrographic work extended that carried out on Cruise 79. Casts were made using various combinations of 1- and 8-litre NIO bottles and 30-litre Niskin bottles (Table 1). The 1-litre bottles, with sets of reversing thermometers, provided thermometric depths for the large-volume bottles and samples for the determination of salinity, dissolved oxygen, silicon and phosphate-phosphorus using standard procedures.

Samples from all three types of bottles were used for the determination of dissolved selenium on board using a recently developed gas-liquid chromatographic procedure. For the measurements of total selenium, aliquots of sea water were subjected to photo-oxidation by ultra-violet irradiation prior to formation of the complex between selenium IV and 4-nitro-o-phenylenediamine. This procedure decomposes organic matter and produces a reproducible disproportionation of selenium between the oxidation states IV and VI. The results, together with the other chemical data, indicate a major role of vertical particulate transport in determining the distribution of selenium, and are particularly significant to an understanding of redox speciation in sea water.

The 30-litre Niskin bottle samples were used for the collection of suspended particulate material by pressurizing the bottles and filtering the contents through 0.4 μm pore size Nuclepore membrane filters. Whenever possible, the entire contents of the bottles were filtered, although 2 to 5 litres of surface samples were sufficient to clog the filters. From the work on Cruise 79, it seems

clear that samples of suspended material collected by Niskin bottles are substantially fractionated on the basis of particle size by settling within the bottles, such that as much as 50% of the mass of the particles in a given bottle is present in the small volume below the lower stopcocks. The volumes below the stopcocks were therefore collected, after the main bottle volumes had been filtered onto separate filters. In addition, a series of closely-spaced deep-water samples was also collected on Station 9636 in order to evaluate this settling effect. The bottles were used as settling chambers, the contents above and below the stopcocks being filtered off at increasingly greater time intervals.

Water samples were collected on Station 9629 for the determination of dissolved iodine at the Institute of Hydrology, Wallingford, and two 60-litre filtered samples were collected on Station 9635 for the preliminary evaluation of an analytical scheme for the lanthanides in seawater at the Department of Earth Sciences, Leeds University.

J. Burnham
J.D. Burton
S.E. Calvert
M.J. McCartney
C.I. Measures
N.R. Merrett
E. Reid

SEDIMENT SAMPLING

a) Gravity Coring

A conventional stainless steel gravity corer, with 10-cm diameter barrels, was used to collect sediment cores. Details of sample recovery are given in Table 1.

Considerable difficulty was experienced in obtaining cores from the Horseshoe and Tagus Abyssal Plains. This was partly due to some problems with the seating of the valve and catcher assemblies, but from the box corer information (see below) it appears that a shallow subsurface layer of stiff clay prevented adequate penetration of the corer for proper retention of a sample by the bottom catcher. No problems were encountered in coring the continental slope sediments off southern Spain and Portugal (Table 1)

b) Box Coring

A modified version of a box corer used first on Cruise 79 was used to collect undisturbed samples of the uppermost sections of the bottom sediments. The new corer consists of a stainless steel box, 30cm square and 60cm in length, on which

up to 200 kg weight can be mounted. The box is provided with perspex windows and sampling p rts and is fitted with two removable plates to allow access to the core. The coring box is closed top and bottom by a pair of closely-fitting shovels mounted on pivoted arms.

The corer is not used on a frame, making deck handling much easier. It is lowered on a commercial life-boat no-load release with the shovels in the fully open position. The box is therefore open and free-flooded at the top and bottom. 25 kg floatation is attached 10m above the no-load release in order to keep the main warp clear of the corer when it is on the bottom.

The corer is lowered at 1m sec^{-1} until it is approximately 50m from the bottom, the distance indicated by a pinger placed 100m up the warp. It is lowered into the bottom at 0.5m sec^{-1} and approximately 20m slack wire is allowed. Impact is easily recorded on the ship's dynamometer. On bottom contact, the no-load release is actuated and the box shovels closed by hauling on the main warp. When the shovels are closed, the corer is lifted clear of the bottom; this could be easily seen on the dynamometer by up to 0.75 ton extra load.

The corer worked with a high degree of success; eight cores were obtained at nine stations (Table 1). There were three failures due to the no-load release not actuating. This was traced to weakened stainless steel springs in the release which allowed the cocking arm to be lowered into the "safe" position during descent. A spare release was then used on subsequent stations.

The cores obtained, ranging from 34 to 61 cm in length, were generally in good condition; the surfaces were well preserved, except at Station 9636 where a very fluid surface layer was slurried on recovery. Some of the core surfaces sloped at an angle to the corer box. This was probably caused by the corer being pulled over at an angle before the shovels had closed properly because of ship's drift.

The cores were sampled on deck through the top of the box and through the side panels using a variety of core tubes. Subsamples were taken for water content, organic carbon, pigment, pore water, chemical and meiofaunal analyses.

S.E. Calvert
R. Peters
E. Reid

PORE WATER SAMPLING PROGRAMME

A total of sixteen sampling drops were made with in situ pore water samplers. All the ten attempts made with the one metre unit were successful: the 2 metre unit failed to return useful samples on four of the six occasions it was used.

On three of these occasions the unit failed to trip, possibly because of insufficient penetration in the hard sediment underlying the superficial layers at these stations. Even at the maximum penetration velocity no indication that the sample trip plate had reached the sediment surface was obtained. On the fourth occasion, failure was due to a burst pressure hose on the unit.

The twelve successful drops returned 95 pore water samples, of total volume 1210ml. Samples were stored immediately at 2°C and analyses were completed as quickly as possible (usually within 2-6 hours) for oxygen, nitrogen, total carbon dioxide, alkalinity and hydrocarbons. Silicate analyses were also made on all samples. These analyses consumed in total 1.5ml of each sample. The remainder was stored at -20°C for analysis at Wormley.

Pore water samples were also obtained by subsampling six of the box cores recovered, and squeezing subsample sections in low pressure hydraulic squeezers within a nitrogen-filled glovebox at the in situ temperature. Since the present design of in situ device does not sample the upper 10cm of the sediment column this procedure obtains information complementary to that obtained from in situ samples, although squeezed samples are less suitable for the study of labile constituents.

With the exceptions noted, all sampling and analytical systems worked well throughout the cruise. Assistance from the ship's officers and members of the crew as well as the acoustics, engineering and computer support personnel was vital to this success, and it is a pleasure to acknowledge this indebtedness. Although weather and swell conditions were not limiting factors on the stations occupied for this work, it would be prudent to insure against future problems by improving deployment and recovery procedures and equipment, so that the samples may be deployed with safety in more severe sea conditions.

T.R.S. Wilson

AEROSOL SAMPLES

AIM

To collect dust samples for both biological and chemical investigations, using meshes and filter systems respectively.

DESCRIPTION

Two systems for dust collection were used on this cruise, one using meshes,

(mesh size 1mm) and the other nuclepore filters (0.4 μm pore size). The dust samples collected on the meshes will be used for a biological investigation. These meshes are approximately 1 metre square and two of these were suspended for periods of 12 hours from the forestay in the bows of Discovery. An anenometer, which registered the number of revolutions in terms of distance (miles), was situated about 1 metre in front of the meshes at a slightly lower level. Readings were taken from this to give an idea of the volume of air filtered, as these samples were taken over time periods, not at stations as with other experiments. Sixteen sets of meshes were used in all, over a period of 13 days, allowance being made for days when the weather was not suitable.

The samples collected on nuclepore filters will be used for a chemical investigation, mainly looking at trace metal concentrations. The filter unit was attached to a pole which was extended over the bows. A pump, powered by a 12V battery was used to pump air through the filter unit at a constant rate of 12 l/min for periods of 12 hours. Twenty-three samples were collected before the weather deteriorated to such an extent that even this system had to be abandoned.

Miss H. Rowson

COMPUTING

1. Navigation, including track charts and immediate display of the ship's position for setting and retrieving the fish trap, and for trawling with the otter trawl.

2. Logging of station data using the "Bio" programme.

3. Reduction of titration data, application of thermometer corrections, and calculation of salinity, potential temperature and associated parameters.

4. Running of the conductivity-temperature-depth (CTD) equipment, together with the sampling and data reduction programme.

5. Daily plotting of true wind speed and directions for the Liverpool University atmospheric particles experiment, and transferring the data to paper tape for later analysis.

6. Daily checking and editing of the automatic meteorological observations.

The equipment functioned reliably, except for some transient problems with the CAMAC interface, the alpha-numeric terminal, the IBM printers and the satellite navigational receiver. No problems arose with the programme used. Some minor programme changes were made to improve the listing of thermometer calibration and hydrographic data. A general programme for plotting variables on Cartesian axes

was written and used to plot graphs of hydrographic data.

R.J.P. Burnham
G. Yarwood

ACOUSTIC SYSTEMS

The P.E.S. fish was deployed p.m. on 23 October and performed satisfactorily for the duration of the cruise.

The MK III Mufax FN3 was used exclusively during the cruise and, apart from a damaged bearing in the Helix Drive motor, which had to be replaced, its performance was also troublefree.

None of the Acoustic Beacons failed at any time although there were occasions, particularly with the otter trawl, when the signal to noise ratio of the received pulses was so poor that it was concluded that the beacons were operating outside the reception beams of the P.E.S. fish despite the use of the beam receiving unit. A standard beacon was modified to increase its output power and looked most promising when used in a trial on a pore water sampler dip. Unfortunately, however, this unit was lost during its first haul on the otter trawl and insufficient components were available on board to repeat the exercise.

The Acoustic Release which was used on the experimental fish trap performed faultlessly on wire tests and operationally. During the second unsuccessful attempt to recover the trap the indications were that the acoustic and electronic systems had operated properly. The fact that the trap did not lift-off even after the back up timer release should have fired indicates that the failure was not attributable to either of these systems.

Weather conditions prevented the use of a new temperature telemeter with the epibenthic sledge which would, it was hoped, also indicate that the camera was operating satisfactorily.

E. Darlington

MAGNESIUM NICKEL ALLOY CORRODABLE LINK TRIALS

Four test pieces were fitted to the fish trap; two of 15% nickel and two of 1% nickel. One example of each alloy was attached to timer units which would record the time when the links parted, and a second example of each alloy was suspended on a nylon cord within the camera's field of view.

The test pieces were all 0.5" in diameter and 2.25" long.

The immersion time was 37 hours, including 30 minutes from sighting to bringing

inboard.

The bottom (4855m) water conditions were as follows: temperature 2.46°C; salinity 34.9‰; oxygen 5.7 ml L^{-1}.

Final diameters were as follows:

Timer		Free suspended	
15% Ni	1% Ni	15% Ni	1% Ni
0.25"	0.31"	0.31"	0.34

R.A. Wild

STN.	DATE 1977	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9624 # 1	23/10	36 0.7N 36 1.3N	7 55.0W 7 54.1W	*PW SAMPLER	1334-1334	1945-2050 NIGHT	60% RECOVERY	1334
9624 # 2	23/10	36 1.4N 36 1.1N	7 53.9W 7 53.9W	WR 30 WR 1 WR 7.4	490-1300	2100-2334 NIGHT	3,7,1 DEEP 1200M NOT TRIP BELOW FAIL	1315
9624 # 3	23/10	36 1.1N 36 0.9N	7 53.9W 7 53.9W	GRAV CORER	1296-1296	2330-0030 NIGHT		1296
9624 # 4	24/10	36 0.8N 36 0.5N	7 54.0W 7 54.8W	GRAV CORER	1296-1296	0050-0215 NIGHT		1296
9624 # 5	24/10	36 0.6N 36 0.1N	7 54.7W 7 54.3W	WR 30 WR 1 WR 7.4	1-1300	0204-0400 NIGHT	4,9,2 BOTTS., SHALLOW PLUS 2 DEEP	1364
9625 # 1	24/10	35 59.6N 36 0.2N	8 28.5W 8 29.3W	GRAV CORER	2507-2507	0640-0820 DAWN		2507
9625 # 2	24/10	36 0.3N 36 0.8N	8 29.4W 8 30.5W	*PW SAMPLER	2524-2524	0830-1003 DAY	NO SAMPLES	2524
9625 # 3	24/10	36 0.8N 36 1.3N	8 30.5W 8 31.2W	GRAV CORER	2507-2507	1005-1154 DAY		2507
9626 # 1	24/10	35 59.6N 35 59.5N	8 54.9W 8 55.7W	WR 30 WR 1 WR 7.4	740-3500	1405-1630 DAY	3,7,2 DEEP, 2400M PRETRIP, REST FAIL	3509
9626 # 2	24/10	35 59.5N 35 59.6N	8 55.7W 8 56.6W	GRAV CORER	3564-3564	1635-1830 DAY		3564
9626 # 3	24/10	35 59.6N 35 59.7N	8 56.7W 8 58.0W	WR 30 WR 1 WR 7.4	25-3500	1855-2235 NIGHT	4,8,1 BOTTS. SHALLOW PLUS 4 DEEP.	3564

STN.	DATE 1977	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9626 # 4	24/10	35 59.7N 35 59.7N	8 58.0W 8 58.2W	WB 30 WB 1	1- 10	2236-2255 NIGHT	1,1,0 BOTTS. SHALLOW.	3570
9627 # 1	25/10	35 59.1N 35 58.9N	9 39.1W 9 40.5W	GRAV CORER4285-4285		0229-0436 NIGHT		4285
9627 # 2	25/10	35 58.9N 35 59.2N	9 40.5W 9 40.3W	GRAV CORER4300-4300		0440-0635 NIGHT		4300
9627 # 3	25/10	35 59.3N 35 59.0N	9 40.8W 9 40.4W	PW SAMPLER4317-4317		0640-0900 DAY		4317
9627 # 4	25/10	35 59.9N 36 0.5N	9 40.4W 9 39.6W	GRAV CORER4256-4256		0903-1103 DAY		4256
9627 # 5	25/10	36 0.6N 36 0.4N	9 39.4W 9 40.8W	BOX CORER 4311-4311		1124-1400 DAY	60CM CORE	4311
9628 # 1	25/10	35 59.8N 36 0.4N	10 48.6W 10 48.5W	GRAV CORER4853-4853		1910-2136 NIGHT	NO CORE	4853
9628 # 2	25/10	36 0.4N 36 1.0N	10 48.7W 10 48.3W	PW SAMPLER4847-4847		2147-0015 NIGHT	NO SAMPLES	4847
9628 # 3	26/10	36 1.0N 36 1.7N	10 48.3W 10 48.7W	WB 30 WB 1 WB 7.4	1490-4800	0030-0605 NIGHT	3,8,3. DEEP. 4000M FAIL. REST O.K.	4847
9628 # 4	26/10	36 1.5N 36 1.2N	10 48.9W 10 49.8W	BOX CORER 4844-4844		0624-0900 DAY	43CM CORE.	4844
9628 # 5	26/10	36 1.2N 36 1.4N	10 49.9W 10 50.3W	WB 30 WB 1 WB 7.4	25-1200	0905-1045 DAY	3,3,9. SHALLOW.	4847
9628 # 6	26/10	36 1.4N 36 1.4N	10 50.3W 10 50.4W	WB 30 WB 1	1- 10	1050-1100 DAY	1,1 BOTTLES. SURFACE.	4847

STN.	DATE 1977	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9629 # 1	27/10	35 47.4N 35 47.0N	13 12.5W 13 14.2W	TRAP B	4855-4855	0224-0436		4855
9629 # 2	27/10	35 48.2N 35 49.0N	13 9.6W 13 10.2W	PW SAMPLER	4855-4855	0347-0635 NIGHT	50% RECOVERY	4855
9629 # 3	27/10	35 48.1N 35 49.4N	13 9.7W 13 10.2W	GRAV CORER	4851-4851	0708-0942 DAY	NO CORE	4851
9629 # 4	27/10	35 48.2N 35 49.2N	13 9.2W 13 8.9W	PW SAMPLER	4855-4855	1015-1300 DAY	86% RECOVERY	4855
9629 # 5	27/10	35 49.2N 35 49.9N	13 8.8W 13 9.8W	WB 30 WB 1 WB 7.4	1490-4800	1308-1625 DAY	3,8,3. DEEP. 4500M AND BELOW PRETRIP	4855
9629 # 6	27/10	35 50.0N 35 51.6N	13 9.9W 13 10.3W	BOX CORER	4851-4851	1643-1920 DUSK	61CM CORE	4851
9629 # 7	27/10	35 47.9N 35 50.0N	13 11.3W 13 11.1W	GRAV CORER	4851-4851	2005-2236 NIGHT	NO CORE	4851
9629 # 8	27/10	35 50.2N 35 51.5N	13 11.1W 13 10.6W	PW SAMPLER	4855-4855	2246-0109 NIGHT	87.5% RECOVERY	4855
9629 # 9	28/10	35 46.7N 35 47.6N	13 14.4W 13 15.0W	WB 30 WB 1 WB 7.4	25-1200	0445-0635 NIGHT	3,9,3 BOTTLES. SHALLOW	4855
9629 # 10	28/10	35 48.0N 35 48.1N	13 13.8W 13 13.9W	WB 30 WB 1	1- 10	0705-0715 NIGHT	1,1 BOTTLES. SURFACE	4855
9629 # 11	28/10	35 47.6N 35 49.2N	13 13.4W 13 13.2W	BOX CORER	4851-4851	0935-1215 DAY	58.5CM CORE	4851
9629 # 12	28/10	35 49.2N 35 49.9N	13 13.4W 13 14.3W	PW SAMPLER	4855-4855	1220-1500 DAY	68% RECOVERY	4855

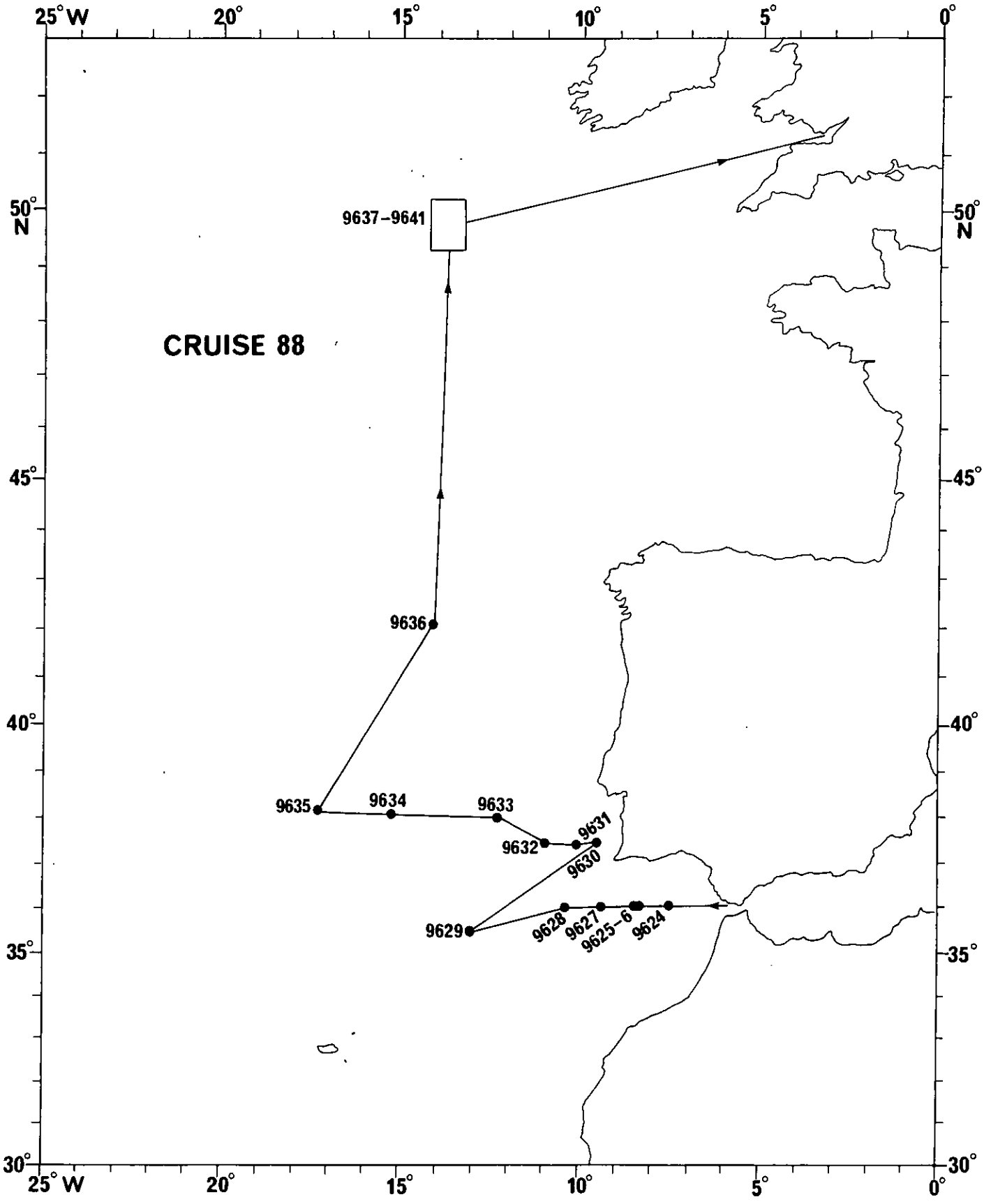
STN.	DATE 1977	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9630 # 1	29/10	37 54.6N 37 54.8N	9 54.8W 9 54.9W	WB 30 WB 1	1050-2300	1030-1220 DAY	3.4 BOTTLES. DEEP	2400.
9630 # 2	29/10	37 54.8N 37 54.7N	9 54.9W 9 54.9W	WB 30 WB 1	1- 10	1222-1255 DAY	1.1 BOTTLES. SURFACE	2400
9630 # 3	29/10	37 54.7N 37 54.6N	9 54.9W 9 55.0W	GRAV CORER	2434-2434	1246-1400 DAY	48CM CORE	2434
9630 # 4	29/10	37 54.6N 37 54.6N	9 55.1W 9 55.6W	PW SAMPLER	2455-2455	1412-1605 DAY	67% RECOVERY	2455
9630 # 5	29/10	37 54.6N 37 54.6N	9 55.7W 9 55.9W	WB 30 WB 1	25- 750	1615-1717 DAY	3.8 BOTTLES. SHALLOW	2455
9631 # 1	29/10	37 52.4N 37 52.9N	10 13.8W 10 14.3W	GRAV CORER	3007-3007	1846-2021 NIGHT	63CM CORE	3007
9632 # 1	30/10	37 52.2N 37 52.3N	10 59.8W 10 59.4W	WB 30 WB 1 WB 7.4	1550-5000	0001-0346 NIGHT	3.8.3. DEEP. 4990M AND 5000M PRETRIP	5021
9632 # 2	30/10	37 52.3N 37 51.7N	10 59.4W 10 57.5W	GRAV CORER	5014-5014	0349-0606 NIGHT	NO CORE	5014
9632 # 3	30/10	37 51.6N 37 50.9N	10 57.5W 10 57.0W	PW SAMPLER	5021-5021	0617-0857 DAWN	82% RECOVERY	5021
9632 # 4	30/10	37 50.9N 37 50.2N	10 57.0W 10 56.9W	BOX CORER	5029-5029	0901-1137 DAY	42CM CORE	5029
9632 # 5	30/10	37 50.3N 37 50.1N	10 56.9W 10 55.9W	WB 30 WB 1 WB 7.4	25-1400	1150-1335 DAY	3.9.3 BOTTLES. SHALLOW	5029
9632 # 6	30/10	37 50.1N 37 50.0N	10 55.9W 10 55.3W	WB 30 WB 1	1- 50	1336-1352 DAY	2.2 BOTTLES. SURFACE	5029

STN.	DATE 1977	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9633 # 1	30/10	38 0.0N	12 31.5W	GRAV CORER	4912-4912	2130-2354 NIGHT	69 CM CORE	4912
		37 59.0N	12 30.3W					
9633 # 2	31/10	37 58.9N	12 30.3W	PW SAMPLER	4920-4920	0004-0240 NIGHT	74% RECOVERY	4920
		37 58.9N	12 29.7W					
9633 # 3	31/10	37 58.9N	12 29.6W	BOX CORER	4927-4927	0249-0512 NIGHT	49 CM CORE	4927
		37 58.7N	12 29.8W					
9634 # 1	31/10	38 10.3N	15 29.1W	BOX CORER	5195-5195	2200-0015 NIGHT	NO SAMPLE	5195
		38 10.4N	15 30.0W					
9634 # 2	1/11	38 10.4N	15 30.1W	PW SAMPLER	5226-5226	0032-0315 NIGHT	64% RECOVERY	5226
		38 10.1N	15 30.7W					
9634 # 3	1/11	38 10.1N	15 30.7W	GRAV CORER	5218-5218	0320-0600 NIGHT	74 CM CORE	5218
		38 9.6N	15 30.4W					

STN.	DATE 1977	POSITION LAT	LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9635 # 1	1/11	38 17.1N 38 16.5N	17 34.4W 17 34.8W	WB 30 WB 1 WB 7.4	3990-5800	1932-2320 NIGHT	3,4,3 BOTTLES. DEEP. ALL PRETRIP	5830
9635 # 2	1/11	38 16.8N 38 17.0N	17 34.8W 17 33.0W	GRAV CORER	5778-5778	2324-0236 NIGHT	102CM CORE	5778
9635 # 3	2/11	38 16.9N 38 16.7N	17 32.5W 17 34.8W	WB 30 WB 1 WB 7.4	3990-5300	0255-0720 NIGHT	3,4,3. DEEP.5090M PRETRIP.BELOW FAIL	5447
9635 # 4	2/11	38 16.7N 38 16.6N	17 34.8W 17 34.0W	PW SAMPLER	5790-5790	0725-1040 DAY	19% RECOVERY	5790
9635 # 5	2/11	38 16.6N 38 16.6N	17 33.9W 17 33.6W	*WB 1 WB 7.4 WB 50	815-5673	1054-1550 DAY	3,6,3. MIDDLE + 1 DEP. 5673M LOST.	5773
9635 # 6	2/11	38 16.3N 38 15.5N	17 35.1W 17 35.0W	BOX CORER	5744-5744	1616-1910 DUSK	NO CORE	5744
9635 # 7	2/11	38 15.8N 38 15.6N	17 35.0W 17 35.1W	WB 30 WB 1 WB 7.4	90-1000	1915-2042 NIGHT	3,5,2 BOTTLES. SHALLOW	5744
9635 # 8	2/11	38 15.7N 38 15.7N	17 35.1W 17 35.1W	WB 30 WB 1	10- 50	2055-2116 NIGHT	2,1 BOTTLES. SURFACE	5744
9635 # 9	2/11	38 17.0N 38 16.5N	17 34.3W 17 34.1W	PW SAMPLER	5797-5797	2215-0117 NIGHT	77% RECOVERY	5797
9635 # 10	3/11	38 16.5N 38 16.5N	17 34.1W 17 33.9W	WB 30 WB 1 WB 7.4	1-2010	0120-0340 NIGHT	4,9,2. ELDERFIELD. 1240M PRETRIP	5775
9635 # 11	3/11	38 16.8N 38 16.0N	17 33.7W 17 34.1W	BOX CORER	5754-5754	0412-0706 NIGHT	TILTED ON ENTRY. 35-40CM CORE	5754

STN.	DATE 1977	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9636 # 1	4/11	42 22.5N 42 21.0N	14 24.2W 14 22.9W	WB 30 WB 1	990-1030	1002-1140 DAY	4.1 BOTTLES. EXPERIMENTAL - SETTLING	5313
9636 # 2	4/11	42 21.1N 42 20.2N	14 22.8W 14 21.9W	BOX CORER	5313-5313	1154-1420 DAY	34 CM CORE	5313
9636 # 3	4/11	42 20.1N 42 18.7N	14 21.4W 14 20.3W	PW SAMPLER	5310-5310	1452-1745 DAY	FAILED TO SAMPLE	5310
9636 # 4	4/11	42 18.7N 42 17.6N	14 20.3W 14 19.6W	GRAV CORER	5313-5313	1750-2046 NIGHT	NO CORE	5313
9636 # 5	4/11	42 17.8N 42 17.6N	14 19.7W 14 19.6W	WB 30	100- 100	2030-2045 NIGHT	1 BOTT. EXPERIMENTAL-REPRODUCIBILITY	5256
9636 # 6	4/11	42 17.6N 42 17.0N	14 19.6W 14 19.7W	PW SAMPLER	5256-5256	2049-2345 NIGHT	67% RECOVERY	5256

STN.	DATE 1977	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	FISHING TIME GMT	REMARKS	MEAN SOUND M.
9637 # 1	7/11	49 48.8N 49 48.9N	14 3.8W 14 0.5W	CTD	1-3940	0943-1345 DAY	CORRECTED LOWER DEPTH 3740M	3994
9638 # 1	8/11	49 52.6N	13 56.1W	TRAP B	3921-3921	2147- NIGHT	TRAP FAILED TO SURFACE	3921
9638 # 2	9/11	49 50.2N 49 50.3N	14 7.3W 14 12.6W	OTSB 14	4043-4104	0256-0428 NIGHT	PINGER LOST FROM BRACKET. NO DIST.	
9639 # 1	12/11	49 52.6N 0 47.0N	13 56.4W 13 55.7W	CTD	20-3820	1458-1733 DAY		3870
9640 # 1	13/11	50 3.2N 50 8.0N	13 50.6W 13 52.7W	OTSB 14	3749-3757	0400-0611 NIGHT		3757
9641 # 1	14/11	50 1.5N	13 45.8W	OTSB 14	0- 0	0117- NIGHT	HAUL ABORTED DUE TO HIGH WINDS	3652



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