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RRS JOHN MURRAY

REPORT ON CRUISE 69/1

January-February 1969

N E. Atlantic

Imperial College Geochemical and Geophysical Cruise

J.S.T.
March 1969

C O N T E N T S

DATES

Sailed from Plymouth		5.1.69
Arrived Agadir	(End of Leg 1)	14.1.69
Sailed from Agadir		16.1.69
Arrived Casablanca	(End of Leg 2)	30.1.69
Sailed from Casablanca		1.2.69
Arrived Lisbon	(End of Leg 3)	7.2.69
Sailed from Lisbon		7.2.69
Arrived Barry	(End of Leg 4)	12.2.69

SCIENTIFIC PERSONNEL

Dr. J.S. Tooms (15.1.69-7.2.69)
Mr. C.P. Summerhayes (4.1.69-7.2.69)
Mr. J. McArthur
Mr. A. Nutter
Mr. G. Glasby (4.1.69-7.2.69)
Mr. C. O'Brien (4.1.69-15.1.69)
Lieut. L. Lima (30.1.69-6.2.69)
Dr. A. Demnati (16.1.69-23.1.69)
(1.2.69-6.2.69)

SHIP'S OFFICERS

Capt. M.J. Perry	Master
Mr. J.E. Higham (up till 15.1.69)	Chief Officer
Mr. G.M. Brown	2nd Officer
Mr. G.H. Selby-Smith	2nd Officer
Mr. H. George	Chief Engineer
Mr. G. Morley	2nd Engineer
Mr. R. Perriam	3rd Engineer
Mr. T.M. Lenord	Bosun

CRUISE 1, 1969

Geochemistry on the Moroccan Shelf

Summary of Cruise Report

Cruise 1 - 1969 proved a highly successful operation. During the 21 days spent on the Moroccan shelf all but the four days in Agadir and Casablanca were fully utilised. In addition, two days were spent on a preliminary reconnaissance survey on the Portuguese shelf and a magnetometer traverse was run from Plymouth to the main work area. A total of more than 340 stations were completed (excluding sub-stations).

The aims of the cruise were to investigate the areas of interest revealed during the 1968 reconnaissance cruise. Of particular interest were the areas of phosphatic rock on two of the 1968 traverses. In addition, it was planned to study further the use of bottom radioactivity measurements in locating phosphate deposits.

Results of preliminary analyses on board the RRS John Murray are extremely encouraging; indeed the results far exceed our greatest expectations. The area of phosphatic rocks (nodules) was mapped in greater detail. In much of

the area the rocks proved to be detrital. Only in the more northerly areas were rock fragments broken off larger (in situ) masses recovered in any quantities. The rock hauls often exceed 100 lbs in weight. One of the specimens given to the Moroccan observer is reported to assay 30% P_2O_5; in excess of any previous published analysis of marine phosphorites.

Unexpectedly a zone of phosphate rich sediments, unrelated to the rock sites, was found on most of the traverses. An almost continuous zone of sediments exceeding 0.25% P_2O_5 with some samples containing more than 3% P_2O_5 was detected at a depth of about 200 metres. In addition, a number of phosphatic areas close inshore were also observed. These results, which could not be foreseen from the 1968 data, are of great significance in terms of present day phosphate formation.

The radioactivity survey is sufficiently encouraging at this stage to have justified our discussing with the U.K.A.E.R.E. Wantage, the joint development of improved equipment.

The preliminary results indicate that additional research is required in this area. No doubt the results of the laboratory work, which is occupying four students and staff full time, will reveal further problems, particularly with regard to volatiles

associated with the phosphates and the use of remote sensing of such volatiles. However, at the present time, the main matters requiring further investigations are: (i) The exact nature of the phosphatic rock (nodule) occurrences. Photographic studies will, it is believed, be an important preliminary feature of this work. In order that the necessary minimum sampling, sparker and radioactivity surveys could be completed, no camera surveys were undertaken during the 1969 cruise; (ii) The possibility of phosphatic sediment at 200 metres in the area of upwelling to the south (the area north of Agadir is not normally an area of upwelling due to offshore winds); (iii) More detailed study of the inshore phosphatic sediments. Only limited sampling has been done inshore; (iv) The area of phosphatic rock to the south of the Canaries detected in 1968; (v) The nature of the sediments beneath the shell sands particularly south of the Canaries.

The carrying of Moroccan and Portuguese observers proved very successful. Because of the limited scientific accommodation, it was necessary to incorporate the observers into the normal watch keeping system. This they also appeared to prefer to being left as strict 'observers' outside the scientific party. They expressed great interest in the work and results

and arrangements have been made to provide them with cuts of samples from their respective shelfs.

Finally, it should be emphasised that the success of the cruise was due in large part to the wholehearted cooperation between the officers and crew and scientists. In fact, the distinction between scientists and others was purely theoretical, the results and programmes being discussed with the ship's officers who made valuable suggestions on possible modifications to improve overall efficiency.

NARRATIVE

The RRS John Murray sailed from Plymouth immediately after completion of shipyard work, on 5th January 1969. The magnetometer was streamed on 6th January. High winds and heavy seas were encountered immediately after sailing and persisted for the whole voyage to Agadir. On 9th January the weather deteriorated further and the ship sheltered for 19 hours off Puerto de Bayona. Agadir was reached on 14th January.

At Agadir two members of the scientific party, Dr Tooms and the Moroccan observer, and a donkey man joined the ship. The First Officer was flown home from Agadir for medical reasons and one scientist, Mr O'Brien, was signed off.

On leaving Agadir perfect working conditions were encountered. A series of traverses were run in areas of phosphatic rock detected during cruise 1, 1968. A sparker-magnetometer traverse was undertaken along each traverse and sampling carried out on a reverse track. Radioactivity was measured at selected stations using a bottom counter. A large number of samples were collected; many being phosphatic. However, whilst good dredge hauls were obtained, the rather soft metal of the dredges was generally badly bent and eventually one of the dredges actually disintegrated.

The Moroccan observer wished to attend a conference in Rabat and the ship stood off Safi on the 23rd January to drop him.

During the latter part of this Agadir-Casablanca leg a number of pipe dredges were lost as well as a chain dredge with the ground tackle. This latter loss was due to the swivel at the head of the ground tackle being snagged. Because of this loss of sampling gear a detailed radioactivity survey, planned for later in the cruise, was carried out. Two-thirds of the way through this survey the counter was snagged and lost. Following this loss all remaining traverses were surveyed using the sparker, proton magnetometer and PDR and Casablanca was entered one day early, on 30th January.

Equipment was repaired in Casablanca and replacements obtained. The Moroccan observer rejoined and a Portuguese observer also joined the ship. Scientists of the Institute du Peche Maritime du Maroc were welcomed on board and there were useful discussions of environmental conditions on the shelf.

The weather continued good for the remainder of the time spent on the Moroccan shelf. Sampling of the traverses was completed on schedule on the 4th February 1969. The PDR fish was rigged during the last traverse so that a comparison could be obtained of results with the fish and with the hull

transducer in shallow to deep waters. Midway from the Moroccan to Portuguese shelf the wind strength increased and the fish was bought inboard as in heavy weather the fish snatches on the cable and is liable to be lost and under such conditions can not be bought inboard without great risk to the crew and fish. The record with the fish showed no improvement over that with a hull transducer.

Work on the Portuguese coast was commenced 5th February. This work was carried out during contingency time which had been allowed in case of bad weather after leaving the Moroccan coast. Three traverses were sampled across the west coast of Portugal following, in each case, a sparker/magnetometer survey. Again the weather was good.

On the morning of the 7th February the ship anchored off the quarantine station, Lisbon to drop the observers and three other scientists. The anchor could not be raised and was eventually left behind when the ship sailed. No major scientific work was planned for the Lisbon-Barry leg, which was fortunate. High winds and heavy seas were encountered throughout this leg. The RRS John Murray entered Barry as scheduled on 12th February after a most successful cruise.

WORK COMPLETED

The vast majority of the research was undertaken along 19 traverses across the Moroccan shelf and 3 traverses across the Portuguese shelf. On one of the Moroccan traverses only a sparker/magnetometer line was completed; the results being insufficiently encouraging to warrant sampling in the available cruise time. In addition to these sampling traverses, a number of sparker and/or proton magnetometer lines were run parallel to the shore.

The work completed on the various traverses (see track chart) is summarised below:-

Leg 1.	Plymouth-Agadir	
	Stations 798-799	1 Proton Magnetometer Station 1 Continuous Seismic Profiling station
Leg 2.	Agadir-Casablanca	
	Stations 800-1011	13 Continuous Seismic Profiling stations and Proton Magnetometer stations 92 Dredge stations 58 Grab stations 64 Radioactivity counter stations 9 Gravity core stations 4 Water bottle stations
Leg 3.	Casablanca-Lisbon	
	(a) Moroccan Shelf Stations 1012-1091	34 Dredge stations 37 Grab stations 8 Gravity core stations 3 Water bottle stations

Leg 3. Casablanca-Liston

(b) Portuguese Shelf
Stations 1092-1136

3 Sparker and Magnetometer stations
16 Dredge stations
20 Grab stations
6 Gravity core stations

Geophysical Data

As mentioned previously, proton magnetometer profiles were undertaken during leg 1 from Plymouth to Agadir. In addition, the magnetometer was streamed during most of the continuous profiling traverses. The records were very satisfactory although there was considerable interference on the record when the sparker was operating. The results have not yet been assessed.

Continuous seismic profiling traverses were undertaken along all the 21 sampling traverses. The results were used on board primarily to control the selection of sampling sites. However, the data are of considerable interest in their own right and it is hoped to interpret the records more fully in the near future. In shallow water (less than 100 fathoms) the most satisfactory record and good penetration was obtained with a 1000 joule system. To the south of latitude 33°30'N a considerable amount of folding and faulting of the sediments was observed with fairly numerous outcrops. In this area there were also a number of minor unconformities within the

the sedimentary sequence. Further north, on the Moroccan shelf, the sediments are generally flat lying and few outcrops were observed. On the Portuguese shelf considerable slumping and folding of the sediment was observed although few rocks were recovered in the dredge. In contrast to the Moroccan shelf, a marked unconformity was apparent on the record between highly folded older rocks and the more recent sediments.

Sediment, Rock and Water Samples

Sampling stations were sited at approximately 2 mile or less intervals along each traverse. The vast majority of dredge stations produced rock samples. These stations were largely selected on the basis of the combined sparker and PDR records and rarely exceeded 0.2 mi in length. In addition to the rocks unconsolidated sediment was obtained at most of the dredge and grab stations. However, in the less shalllow waters, over 100 to 200 metres, the samples in the grab tended to wash out during recovery.

Gravity core stations were collected at a number of localities to study the distribution of elements within the sediment and also to investigate the composition of the interstitial waters in comparison with the overlying sea water. Several of the cores exceeded 6 ft in length. The cores were

normally sectioned immediately on being bought inboard. As far as possible, interstitial water was squeezed from the sediment as soon as possible after sectioning. However, the rate of squeezing was relatively slow and it was not possible, therefore, to squeeze all the samples as soon after collection as ideally desirable. Accordingly, splits of certain samples were squeezed immediately after collection so that the effect of delayed squeezing could be assessed.

The vast majority of rock samples collected were limestones or argillaceous limestones. However, few rocks were collected on the five most northerly traverses on the Moroccan shelf and on the Portuguese shelf. Many of the limestones were phosphatic (Fig. 2). These phosphatic rocks were often conglomeratic with commonly a glauconitic cement. Particularly on the more southerly traverses the vast majority of rock samples were boulders.

Unconsolidated sediment samples varied in composition from sand to shell sand to muds. In the cores granulometric banding was observed and there was generally a marked change of colour over the first few centimetres, probably reflecting variations in the oxidation reduction potential.

Ship board analysis of the sediment samples disclosed a zone of abnormally high phosphate contents at a depth of approximately 200 metres on the Moroccan shelf which was unrelated to the occurrences of phosphatic rocks (Fig. 2). High phosphate

contents were also observed in the vicinity of the phosphatic rocks and at a number of localities close inshore. It is possible that these inshore occurrences are more extensive than indicated on the map as sampling was not normally extended very close inshore.

Only a few analyses of sediments was completed on the Portuguese shelf and although some relatively high phosphate contents were observed, it is not possible at this time to make any definite statements on distribution.

Radioactivity Counter

Following the encouraging results obtained in the laboratory on correlating high radioactivity with high P_2O_5 contents in rocks, trials were made on this cruise using a bottom counter loaned by the Atomic Energy Research Establishment, Wantage. Difficulties were encountered due to the sensitivity of the electronics to shock. This was a feature of this unit which, due to shortage of time, it had not been possible to fully check before sailing. Because of this feature, it was necessary to pay out enough electrical cable to ensure that the counter was stationary on the bottom which increased the risk of snagging and probably contributed to the eventual loss of the counter. The counter was only marginally negatively buoyant and weight had, therefore, to be attached to cause it to sink rapidly.

Counting at point sites raises a number of problems. In particular, the counting was normally carried out at the end or beginning of a dredge station and the results cannot be strictly correlated with the dredge station. To overcome this it would be necessary to use a towed counter. This would have the advantage of giving a continuous record and would permit a recovery line to be attached to the counter for use if the electrical cable parted when the counter was snagged. It is hoped to develop such apparatus in collaboration with the Atomic Energy Research Establishment.

Counts ranging between 5 cps and 120 cps were recorded. At a number of stations the counts were also integrated over a period of 100 seconds and a very good correlation was observed. The majority of the higher counts could be correlated with phosphate dredge stations. However, a number of low counts were recorded where phosphate was dredged and vice versa. This is tentatively attributed to the fact that the counter was offset from the actual dredge site. It is proposed to investigate such anomalies further in the future using the underwater camera and by carrying out additional dredge stations. During the present cruise the limited time available was insufficient to carry out such an investigation without sacrificing certain other aspects of the programme which were rated as of higher priority.

Stations Worked

In the following list of stations many of the dredge sites are given only a single location. This is the location of the commencement of the dredge station. Such dredge stations were generally of a tenth of a mile or less in extent. For longer dredge stations the location of the start and finish of the station is given.

STATION LIST

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
798	PM	6.1.69 7.1.69 9.1.69 10.1.69 14.1.69	1350 0945 	 0200 0845	48°13' 47°04' 42°7.9' 42°07.8' 3°29.8'	05°26' 06°15.5' 08°53.7' 08°52.2' 09°45.5'			
799	CSP	13.1.69	0500	0640	33°20' 33°25'	08°32.1' 08°34.5'			Sparker trials.
TRAVERSE 1									
800	CSP	16.1.69	1210	1925	30°25' 30°28.8'	09°40' 10°13.2'			
801	RAC	"	2030	0046	30° 33.8'	10°24.7'	500	940	Testing equipment. O-ring failure electronics replaced, successful 2nd trial.
802	GC	17.1.69	0308	0328	30°33.8'	10°15.1'	530	997	2'9" core. Greenish grey silt.
803	GC	"	0500	0525	30°30.5'	10°07.2'	284	535	4'7½" core. Brown mud at top, grey at bottom.
804	RD/PD	"	0585	0645	30°29'	10°04.2'	136 124	256 234	Fine muddy green sand in pipe.
805	G	"	0720	0736	30°28'	9°57'	64	121	Glauconitic medium sand.
806	G	"	0818	0848	30°28.4'	09°52.0'	48	90	Mud.
807	RAC	"	1525	1600	30°28.4'	09°52.0'	48	90	Electronic failure, station abandoned.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
808	GC	17.1.69 18.1.69	2110	0700	31°25.5' 31°03.5'	10°22.3' 10°27.8'	309	582	Core barrel lost overboard - threads worn.
TRAVERSE 2									
809	GC	18.1.69	0817	0827	31°03.7'	10°27.8'	312	586	5'4" core, brown mud.
810	RD/PD	"	0925	1005	31°04.8'	10°24'	249	469	Brown mud.
811	GC	"	1050	1105	31°04.0'	10°19'	212	399	3' gritty glauconitic mud.
812	G	"	1136	1153	31°03.8'	10°14'	138	260	Coarse shelly glauconitic sand.
813	RD/PD	"	1223	1256	31°06.0'	10°13.9'	124 116	234 219	Glauconitic sand, phosphorite?, coal and clinker.
814	G	"	1348	1355	31°04'	10°10'	98	185	Medium sand.
815	GC	"	1409	1419	31°04'	10°07.7'	76	143	2" brown glauconitic sand and shelly limestone bedrock.
816	RAC	"	1428	1436	31°04'	10°07.7'	76	143	
817	RD/PD	"	1449	1515	31°04'	10°06.4'	68	128	Glauconitic muddy sand and phosphorite?
818	RD/PD	"	1530	1554	31°04.3'	10°05.2'	61	115	Green glauconitic mud, siltstone, sandstone, phosphorite?
819	G/RAC	"	1612	1652	31°04.2'	10°03.2'	46	87	Coarse shell sand and limestone.
820	G/RAC	"	1658	1700	31°03.9'	10°02.2'	45	85	Brown muddy shell sand.
821	RD/PD/RAC	"	1719	1807	31°03.6'	10°01'	52	98	Pebbly brown mud and limestone.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
822	RAC/G	18.1.69	1818	1836	31°04.2'	09°59.7'	52	98	Greenish brown sandy mud.
823	RD/PD/RAC	"	1848	1946	31°04.2'	09°58.4'	48 44	90 83	Brown shelly mud and pebbles.
824	RD/PD/RAC	"	1942	2019	31°04'	09°57.2'	48 40	90 75	Brown shelly mud.
825	G/RAC	"	2040	2051	31°04.4'	09°55'	37	70	Sand.
826	RD/PD/RAC	"	2106	2142	31°05'	09°53.2'	29	55	Brown muddy sand with large shells and siltstone pebbles.
827	RD/PD/RAC	"	2215	2244	31°07.6'	09°56.3'	44	83	Brown sandy mud.
TRAVERSE 3									
828	CSP	18.1.69 19.1.69	2350	 0815	31°17.0' 31°11.6'	09°56.9' 09°56.4'			Sparker traverse commenced.
829	RD/PD/RAC	19.1.69	0918	0956	31°11.7'	09°57.3'	45	85	Muddy pebbly sand with limestone.
830	RD/PD	"	1007	1036	31°11.75'	09°59.7'	52	98	Brown muddy shell sand with pebbles.
831	RD/PD/RAC	"	1048	1124	31°11.5'	10°01.15'	57 55	107 104	Brown glauconitic muddy sand with siltstone.
832	G/RAC	"	1132	1200	31°11.4'	10°02.7'	63	119	Glauconitic muddy sand.
833	RD/PD/RAC	"	1230	1311	31°11.3'	10°04'	66	124	Green muddy sand and phosphorite?
834	RD/PD/RAC	"	1324	1359	31°11.2'	10°05.8'	66	124	Muddy glauconitic sand with flint mudstone.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
835	G/RAC	19.1.69	1410	1420	31°11.6'	10°06.9'	65	122	Glauconitic sand.
836	RD/PD/RAC	"	1436	1505	31°11.5'	10°08.9'	70	132	Glauconitic black sand and siltstone.
837	RD/PD/RAC	"	1525	1600	31°11.8'	10°10.4'	93	175	Shelly glauconitic sand and sandstone.
838	G/RAC	"	1619	1645	31°11.5'	10°13.4'	140	264	Black glauconitic sand.
839	GC/RAC	"	1658	1723	31°11.2'	10°15'	156	294	5½ ft. glauconitic black and brown sand.
840	G/RAC	"	1756	1826	31°11.3'	10°16.6'	162	305	Black sand.
841	RD/PD/RAC	"	1848	1930	31°11.4'	10°18.7'	170	320	Muddy glauconitic sand.
842	G/RAC	"	2000	2035	31°10.4'	10°23.1'	238	448	Muddy glauconitic sand.
843	GC/WB	"	2108	2204	31°09.8'	10°27.8'	272	512	2'9" brown mud top and green sand bottom.
TRAVERSE 4									
844	GC/WB	19.1.69	2241	2327	31°14.4'	10°29.8'	296	558	4'4" brown mud top and green sand bottom.
845	CSP/PM	19.1.69 20.1.69	2344	 1112	31°18.5' 31°24.8'	10°30.1' 10°27.2'			
846	G/RAC	20.1.69	1242	1306	31°15'	10°26.5'	253	447	Black sand.
847	RD/PD	"	1322	1418	31°15.4'	10°24.6'	162	305	Phosphatic? conglomerate and coarse shell sand.
848	RD/PD/RAC	"	1427	1510	31°15.7'	10°23.1'	150 136	283 256	Phosphatic? conglomerate and coarse shell sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
849	GC/RAC/WB	20.1.69	1533	1600	31°15.8'	10°19'	207	390	1'5" glauconitic sand
850	G/RAC	"	1639	1703	31°16.1'	10°16.5'	176	332	Black glauconitic sand
851	G/RAC	"	1735	1753	31°16.2'	10°14.3'	144	271	Black glauconitic sand
852	G/RAC	"	1804	1821	31°16.7'	10°12.2'	112	211	Black glauconitic sand
853	G/RAC	"	1832	1846	31°16.4'	10°09.7'	70	132	Coarse muddy sand.
854	RD/PD	"	1858	1944	31°16.2'	10°06.8'	68	128	Pebbly black sand.
855	RD/PD	"	2000	2020	31°16.6'	10°05.0'	64	121	Coarse muddy sand and limestone.
856	RD/PD/RAC	"	2103	2144	31°16.6'	09°59.8'	59	111	Brown mud.
857	RD/PD	"	2158	2219	31°16.8'	09°57.7'	52	98	Brown mud.
TRAVERSE 5									
858	CSP	20.1.69	2230	2331	31°18.8' 31°36.3'	09°57.7' 09°59'			
859	RD/PD/RAC	"	2345	0010	31°27'	09°59'	46	87	Brown mud and glauconite coated pebbles.
860	G	21.1.69	0026	0032	31°26.9'	10°00.6'	51	96	Brown mud.
861	G/RAC	"	0047	0105	31°26.7'	10°02.6'	63	119	Brown mud.
862	RD/PD	"	0117	0132	31°26.5'	10°04.3'	70	132	Brown muddy sand.
863	G/RAC	"	0144	0159	31°26.55'	10°05.8'	70	132	Black sand.
864	G	"	0214	0224	31°26.4'	10°07.9'	73	138	Muddy glauconitic sand and pebbles.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth UCF	Range CM	Comments
865	RD/PD/RAC	21.1.69	0326	0303	31°26.1'	10°09.7'	74	139	Medium sand, sandstone and phosphorite?
866	RD/PD	"	0312	0357	31°26.0'	10°11.5'	131 166	247 313	Medium shell sand.
867	G	"	0400	0411	31°25.8'	10°15'	316	595	Glauconitic sand.
868	GC/WB	"	0433	0540	31°25.6'	10°18.6'	103	1025	5'2½" brown and green sandy mud.
TRAVERSE 6									
869A	RD/PD	21.1.69	0557	0720			562	1057	Abandoned due winch troub troubles.
869	G/RAC	"	1148	1200	31°32.8'	09°54.4'	39	73	Brown mud.
870	G	"	1226	1231	31°32.7'	09°56.7'	44	83	Brown mud.
871	RD/PD/RAC	"	1640	1714	31°32.3'	09°58.8'	40	75	Delayed due winch troubles. Coarse, shell sand and fine grained limestone.
872	RD/PD/RAC	"	1755	1820	31°32.1'	10°02.1'	62	117	Brown mud.
873	RD/PD/RAC	"	1835	1850	31°32'	10°05'	70	132	Muddy black glauconitic sand.
874	G/RAC	"	1857	1915	31°31.5'	10°06.6'	70	132	Muddy black glauconitic sand.
875	RD/PD/RAC	"	1929	1952	31°31.6'	10°09.2'	72	136	Muddy shelly sand with flint, sandstone and phosphorite?
876	RD/PD/RAC	"	2036	2120	31°31.05'	10°11'	72	136	Shell sand with mudstone.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
877	RD/PD	21.1.69	2126	2152	31°31'	10°12.3'	80 73	151 138	Shell sand with phosphorite?
878	G	"	2211	2225	31°30.4'	10°14.2'	302	569	Muddy glauconitic sand.
879	GC	"	2251	2312	31°30.3'	10°18.6'	482	906	4'8" core. Brown mud top, green sand centre, grey mud bottom.
TRAVERSE 5									
880	RD/PD	22.1.69	0013	0057	31°26'	10°25.1'	490	921	Siltstone and glauconitic sand.
881	GC	"	0132	0184	31°24.9'	10°26.7'	514	966	No core.
882	RD/PD	"	0220	0244	31°24.9'	10°24.0'	400	753	Mudstone and glauconitic sandy mud.
883	RD/PD	"	0256	0334	31°25.3'	10°22'	472	888	Limestone, phosphorite? and glauconitic sandy mud.
TRAVERSE 7									
884	CSP/PM	22.1.69	0400	1220	31°28.4'	10°21.9'			
885	G/RAC	"	1240	1253	31°52.2'	09°33.0'	10	19	Fine sand.
886	G	"	1322	1327	31°51.8'	09°36.2'	17	32	Pebbles with muddy fine sand.
887	G/RAC	"	1353	1402	31°51.6'	09°39.7'	20	38	Pebbly shell sand.
888	G/RAC	"	1429	1437	31°51.5'	09°43.4'	20	38	Coarse shell sand.
889	G	"	1502	1508	31°51.3'	09°46.9'	22	41	Coarse shell sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth UCF	Range CM	Comments
890	RD/PD	22.1.69	1600	1615	31°51.0'	09°51.5'	39	73	Brown mud.
891	RD/PD	"	1648	1704	31°51.3'	09°55.2'	52	98	Muddy glauconitic sand
892	RD/PD/RAC	"	1745	1808	31°51.6'	09°56.8'	56	105	Calcareous rocks and shells.
893	RD/PD/RAC	"	1828	1850	31°52.2'	09°59.7'	74	139	Phosphorite? and glauconitic muddy sand.
894	RD/PD/RAC	"	1908	1928	31°52'	10°01.6'	71	134	Sandstone and muddy shell sand.
895	RD/PD	"	1938	1948	31°51.8'	10°02.7'	69	130	Muddy sand and rock.
896	RD/PD	"	2018	2057	31°51'	10°07.5'	72	136	Siltstone and phosphorite? with muddy shell sand.
897	G	"	2115	2123	31°51.5'	10°08.6'	160	301	Shelly sand.
898	RD/PD	"	2145	2218	31°51.7'	10°10.2'	76	143	Conglomerate (phosphatic?) and shell sand.
899	RD/PD	"	2310	2335	31°51.3'	10°15.2'	168	316	Conglomerate (phosphatic?) and silt.
TRAVERSE 8									
900	CSP/PM	23.1.69	0420	0915	32°11.2'	09°58'			
901	G	"	1020	1130	32°18.8'	09°15.8'	12	23	Shell sand.
902	G	"	1200	1208	32°18.1'	09°19.9'	21	40	Shell sand.
903	RD/PD/RAC	"	1219	1240	32°17.9'	09°22.2'	22	41	Shelly limestone and siltstone with shell sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
904	RD/PD/RAC	23.1.69	1256	1316	32°17.2'	09°24.6'	22	41	Shelly limestone and siltstone with shell sand.
905	G	"	1331	1338	32°17'	09°26.9'	24	45	Shell sand.
906	RD/PD	"	1359	1415	32°16.8'	09°28.3'	26	49	Sandstone, limestone, flint and shell sand.
907	RD/PD	"	1435	1500	32°16.0'	09°31.9'	32	60	Siltstone and shell sand.
908	RD/PD/RAC	"	1516	1536	32°15.7'	09°33.4'	28	53	Mudstone and shell sand.
909	RD/PD/RAC	"	1545	1607	32°15.3'	09°35.1'	28	53	Shelly sst. and shell sand.
910	RD/PD/RAC	"	1620	1638	32°15'	09°37.8'	24	45	Algal. crust and sst.
911	RD/PD/RAC	"	1643	1703	32°14.6'	09°38.6'	31	58	Sst. and shell sand.
912	G	"	1745	1752	32°14.4'	09°42.5'	48	90	Fine brown sand.
913	G	"	1810	1818	32°13.9'	09°44.8'	60	113	Muddy fine sand.
914	RD/PD	"	1852	1913	32°13.7'	09°46.7'	66	124	Mudstones, sandstone and shell sand.
915	RD/PD	"	1928	1948	32°13.2'	09°50.2'	130	245	Siltstone, phosphorite? and mud.
916	RD/PD/RAC	"	2015	2046	32°12.3'	09°49.6'	70	132	Mudstone and limestone.
917	RD/PD	"	2122	2156	32°13.3'	09°53.2'	416	783	Empty.
918	GC/WB	"	2229	2400	32°11.8'	09°56.2'	840	1579	9" core. Brown mud.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
TRAVERSE 9									
919	CSP/PM	24.1.69	0542	0900	32°30.5'	09°17'			
920	RD/PD	"	0933	1015	32°31.2'	09°45.6'	618	1162	No sample (pipe dredge too light).
921	G	"	1030	1050	32°30.2'	09°44.6'	448	843	2'10" core, brown silty mud (core catcher reversed.
922	RD/PD/RAC	"	1110	1141	32°30.5'	09°41.4'	80 87	151 164	Sandstone and glauconitic muddy sand.
923	RD/PD/RAC	"	1209	1235	32°31.4'	09°40.7'	82	151	Phosphatic? congl. and shelly sand.
924	RD/PD/RAC	"	1255	1323	32°30.8'	09°37.8'	64	121	Siltstone, limestone and shell sand.
925	G	"	1335	1339	32°30.7'	09°36.0'	46	87	Shelly sand.
926	G/RAC	"	1355	1405	32°30.7'	09°34.1'	52	98	Shelly muddy sand.
927	G	"	1420	1424	32°30.7'	09°32.6'	50	94	Brown glauconitic sand.
928	RD/PD/RAC	"	1443	1513	32°30.7'	09°31.2'	46	87	Medium sand.
929	G	"	1527	1530	32°30.7'	09°28.9'	34	64	Coarse shell sand.
930	RD/PD/RAC	"	1541	1600	32°30.6'	09°28.4'	38	72	Sst. algal crusts and shelly sand.
931	RD/PD	"	1628	1640	32°30.7'	09°27'	34 38	64 72	Sandy limestone and mud-stone and shell sand.
932	RD/PD	"	1716	1745	32°30.6'	09°25.2'	26	49	Limestone, algal crusts and shell sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth UCF	Range CM	Comments
933	RD/PD	24.1.69	1757	1810	32°30.8'	09°24.1'	34	64	Fractured argil. limestone, mudstone and shell sand.
934	RD/PD	"	1830	1848	32°30.9'	09°22.6'	33	62	Shell sand.
935	G/RAC	"	1906	1920	32°30.5'	09°21'	29	55	Shell sand.
936	G	"	1931	1936	32°30.6'	09°19.2'	25	47	Silty mud.
937	G	"	1947	1954	32°30.6'	09°17.3'	18	34	Shell sand.
TRAVERSE 10									
938	CSP/PM	24.1.69 25.1.69	2200	0400	32°41.5' 32°53'	09°09' 09°35'			
939	GC	"	0446	0515	32°53'	09°35'	804	1511	5'10" core brown mud top, grey mud bottom.
940	RD/PD	"	0538	0635	32°52.4'	09°32.1'	642	1207	Brown mud.
941	GC	"	0648	0704	32°51.8'	09°30.4'	218	411	6'4" sandy mud top, greenish mud bottom.
942	RD/PD	"	0721	0743	32°51.3'	09°28.5'	77	145	Siltstone and shell sand.
943	G	"	0755	0802	32°51'	09°21.8'	72	136	Muddy shell sand.
944	G/RAC	"	0826	0834	32°50.8'	09°25.4'	62	113	Shell sand.
945	G	"	0852	0857	32°50.5'	09°23.6'	57	107	Shell sand.
946	G	"	0914	0922	32°50'	09°22.2'	56	105	No sample.
947	G/RAC	"	0955	1005	32°49.6'	09°20.4'	50	94	Shell sand and coral.
948	RD/PD/RAC	"	1026	1045	32°49'	09°18.3'	55	104	Calc. mudstone and shell sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
949	RD/PD/RAC	25.1.69	1102	1124	32°48.3'	09°15.9'	54	102	Limestone and shell sand.
950	RD/PD/RAC	"	1138	1153	32°47.2'	09°15'	51	96	Shell sand and phosphorite?
951	G	"	1248	1255	32°47.6'	09°13'	51	96	Fine brown muddy sand.
952	RD/PD	"	1320	1333	32°46.5'	09°10.8'	48	90	Argil. limestone and silty mud.
953	G	"	1353	1402	32°46'	09°08.7'	44	83	Shell sand.
954	RD/PD	"	1420	1444	32°45.4'	09°06.4'	34	64	Shell sand and conglomerate.
955	PM	25.1.69 26.1.69	1754	0100	33°06.6' 33°09.2'	09°00' 09°23'			
955A	CSP	25.1.69 26.1.69	1754	0100	33°06.6' 33°09.2'	09°00' 09°23'			
956	RD/PD	26.1.69	0257	0324	33°07.9'	09°19.3'	208	392	Fine sandy mud.
TRAVERSE 11									
957	GC	26.1.69	0341	0352	33°07.3'	09°16.7'	122	230	2' muddy sand. Brown top then green.
958	RD/PD	"	0418	0440	33°06.4'	09°13.8'	76	143	Impure limestone and shell sand.
959	RD/PD	"	0505	0520	33°05.8'	09°09.8'	67	126	Limestone and phosphorite? with shell sand.
960	RD/PD	"	0559	0625	33°05'	09°06.7'	56	105	Algal encrusted mudstone. Shell sand.
961	RD/PD	"	0645	0720	33°04.5'	09°04.3'	59	111	Algal. encrusted limestone and phosphorite? with shell sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
962	G	26.1.69	0734	0747	33°04.2'	09°02.9'	58	109	Pebbly shell sand.
963	RD/PD	"	0800	0816	33°03.7'	09°01.4'	61	115	Limestone and phosphorite? and shell sand.
964	RD/PD	"	0920	0940	33°03.7'	09°01.0'	61	115	(Power failure on gallows) Limestone and phosphorite? with shell sand.
965	RD/PD	"	1313	1327	33°03.2'	08°58.5'	52	98	Sandy siltstone and muddy sand.
966	RD/PD	"	1351	1408	33°02.6'	08°56.8'	48	90	Calc. mudstone and phosphorite pebble? with shell sand.
967	G	"	1418	1426	33°02.2'	08°55.2'	54	102	Shell sand.
968	RD/PD	"	1440	1453	33°02.1'	08°54.7'	52	98	Brown silty mud.
969	G	"	1506	1514	33°01.7'	08°52.6'	42	79	Brown sticky mud.
970	RD/PD	"	1524	1539	33°01.5'	08°52'	34	64	Muddy shell sand.
971	G	"	1549	1555	33°01.2'	08°50.7'	26	49	Shell sand.
972	RD/PD	"	1605	1614	33°01.1'	08°50'	21	40	Shell sand and algal crusts.
973	G	"	1628	1635	33°00.4'	08°47.7'	16	30	Phosphorite? and limestone pebbles with shell sand.
TRAVERSE 12									
974	RD/PD	26.1.69	1730	1745	33°04.0'	08°47.9'	25	47	Algal encrusted shelly limestone and shell sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
975	G	26.1.69	1758	1809	33°04.5'	08°49.2'	30	57	Shell sand.
976	RD/PD	"	1822	1840	33°04.7'	08°50.8'	45	85	Mud and shell sand and mudstone and sandstone.
977	RD/PD	"	1858	1914	33°04.6'	08°52.7'	50	94	Sandy mud.
978	RD/PD	"	1938	1948	33°05.4'	08°54.5'	47	89	Mudstone and argil. limestone with shell debris.
979	RD/PD	"	2005	2021	33°05.6'	08°56.7'	51	94	Argillite and sand.
980	RD/PD	"	2033	2055	33°06'	08°57.6'	60	113	Argillite, shelly argillite, brown muddy shelly sand.
981	RD/PD	"	2119	2137	33°06.3'	08°59.0'	62	117	Sandy brown mud.
982	RD/PD	"	2153	2214	33°06.4'	09°00.1'	58	109	Sandy brown mud with phosphorite? and limestone.
983	CSP/PM	26.1.69 27.1.69	2236	0420	33°06.6' 33°06.2'	09°00.4' 08°42.4'			
TRAVERSE 13									
984	G	27.1.69	0430	0434	33°06.2'	08°42.4'	14	26	Algal crusts only.
985	RD/PD	"	0454	0509	33°06.3'	08°43.6'	20	38	Fractured sst. and shell sand.
986	G	"	0528	0644	33°06.8'	08°46.0'	36	68	Coarse shell sand.
987	RD/PD	"	0723	0731	33°07'	08°47.9'	37	70	Mudstone and sandstone and coarse shell sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
988	RD/PD	27.1.69	0742	0802	33°07.2'	08°48.7'	48	90	Mudstone, limestone, phosphorite? shelly sandy mud.
989	RD/PD	"	0836	0850	33°07.6'	08°49.5'	50	94	Limestone slab and mud.
990	RD/PD	"	0903	0915	33°07.8'	08°51.3'	46	87	Snagged, main warp parted. Station abandoned.
991	G	"	1000	1010	33°07.9'	08°53.0'	60	113	Brown sandy mud.
992	G	"	1020	1026	33°08.4'	08°54.3'	61	115	Shell sand.
993	G	"	1041	1045	33°08.5'	08°56'	62	117	Shell sand.
994	RD	"	1058	1115	33°08.6'	08°58'	60	113	Empty.
995	RD	"	1153	1210	33°09.5'	08°59.6'	63	119	Algal encrustations.
996	RD	"	1231	1248	33°09.3'	09°02'	60	113	Mudstone (fresh fractured) and algal crust.
997	RD	"	1300	1326	33°10'	09°03'	64	121	Phosphorite? pebble
998	G	"	1339	1345	33°10.3'	09°05'	68	128	Fine brown silty sand.
999	RD/PD	"	1358	1416	33°10.9'	09°07.2'	68	128	Shell sand.
TRAVERSE 12									
1000	G	27.1.69	1441	1500	33°08.2'	09°10.3'	68	128	Fine silty sand.
1001	RD/PD	"	1518	1542	33°07.8'	09°08.5'	68	128	Sst. pebbles; lost pipe.
1002	G	"	1554	1600	33°07.7'	09°07.5'	68	128	Coarse shelly sand.
1003	RD/PD/G	"	1621	1648	33°07.3'	09°06.2'	63	119	Coarse shelly sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
1004	RD/PD	27.1.69	1708	1726	33°07.1'	09°04.4'	63	119	(Rock dredge broken) Conglomeratic phosphorite? limestone, mudstone.
1005	G	"	1752	1759	33°07'	09°03.4'	61	115	Shelly sand.
1006	G	"	1808	1815	33°06.8'	09°01.8'	61	115	Fine shelly sand and phosphorite? pebbles.
1007	G	"	1833	1843	33°03.2'	09°00.5'	60	113	Shelly sand.
TRAVERSE 14									
1008	CSP/PM	27.1.69 28.1.69	2028	0700	33°15.8' 33°18.1'	09°00.2' 08°35.1'			
1009	RAC	28.1.69	1028	1842	33°01.4'	08°49.9'	23 60	43 113	26 substations. Counter lost at station 1009.26.
TRAVERSE 15									
1010	CSP/PM	29.1.69	0350	0906	33°25.6'	08°16.3'			
TRAVERSE 16									
1011	CSP/PM	29.1.69 30.1.69	1307	0200	34°05.2' 34°12.9'	08°04.1' 07°12.8'			
TRAVERSE 17									
1012	PM	1.2.69	0930	1530	33°38.3' 33°13.6'	07°39.9' 08°37.7'			
TRAVERSE 14									
1013	G	1.2.69	1552	1616	33°11.2'	08°39.7'	21	40	Fine sand.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
1014	RD/PD	1.2.69	1643	1658	33°11.7'	08°42.1'	39	73	Limestone.
1015	RD/PD	"	1730	1743	33°11.6'	08°41.7'	42	79	Calcareous mudstone.
1016	RD/PD	"	1812	1824	33°12.1'	08°44.3'	46	87	Phosphorite? limestone and mud.
1017	RD/PD	"	1846	1901	33°12.7'	08°45.7'	48	90	Argillaceous limestone.
1018	G	"	1910	1928	33°12.8'	08°47.0'	54	102	Sandy mud.
1019	G	"	1942	1949	33°13.2'	08°48.2'	56	105	Silty mud.
1020	RD/PD	"	2018	2037	33°13.5'	08°49.7'	58	109	Sandy mud.
1021	G	"	2050	2100	33°13.8'	08°50.6'	58	109	Mud and algal crusts.
1022	RD/PD	"	2112	2132	33°14.1'	08°52'	58	110	Siltstone and mud
1023	G/WB	"	2140	2207	33°14.3'	08°52.9'	60	113	Fine sand.
1024	RD/PD	"	2221	2259	33°14.6'	08°54.6'	62	117	Algal crust only.
1025	RD/PD	"	2308	2325	33°15.0'	08°55.2'	62	117	Algal crust only.
1026	G	"	2339	2355	33°15'	08°56.5'	62	117	Shelly sand.
1027	G	2.2.69	0005	0036	33°15.5'	08°57.4'	62	117	Shelly sand.
1028	RD/PD	"	0052	0112	33°15.6'	08°59.8'	70	132	Sandstone and coarse sand.
TRAVERSE 15									
1029	GC	2.2.69	0156	0226	33°19.1'	08°56.5'	80	151	1'1" core black and brown sand.
1030	G	"	0245	0300	33°19.6'	08°54.6'	77	145	Sand.
1031	RD/PD	"	0314	0336	33°19.0'	08°52.8'	69	130	Sand and sandstone pebble.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth UCF	Range CM	Comments
1032	G	2.2.69	0350	0405	33°19.0'	08°52.1'	66	124	Shelly sand.
1033	RD/PD	"	0423	0442	33°18.7'	08°50.3'	62	117	Shell sand and limestone.
1034	G	"	0454	0501	33°18.2'	08°49.2'	64	121	Muddy shell sand.
1035	RD/PD	"	0510	0525	33°18.1'	08°48'	60	113	Muddy shell sand with phosphorite? and limestone.
1036	RD/PD	"	0543	0558	33°17.6'	08°46.7'	52	98	Shell sand.
1037	RD/PD	"	0624	0640	33°17.3'	08°45.4'	58	109	Shell sand and phosphorite?
1038	RD/PD	"	0703	0720	33°16.8'	08°43.5'	54	102	Shell sand and limestone.
1039	G	"	0730	0736	33°16.6'	08°42.3'	50	94	Mud.
1040	RD/PD	"	0752	0802	33°15.9'	08°40.5'	44	83	Brown mud and shelly limestone.
1041	RD/PD	"	0820	0905	33°15.7'	08°39.5'	35	66	Shelly mud.
1042	G	"	0925	0931	33°15.1'	08°36.3'	20	38	Shell.
TRAVERSE 17									
1043	RD/PD	2.2.69	1208	1224	33°25.6'	08°16.3'	13	24	No sample.
1044	RD/PD	"	1240	1259	33°27.1'	08°17.1'	16	30	Algal crust only.
1045	G	"	1314	1322	33°27.9'	08°17.6'	19	36	Shell.
1046	RD/PD/G	"	1336	1359	33°28.9'	08°18.4'	25	47	Silty mud.
1047	RD/PD	"	1411	1428	33°29.4'	08°19.4'	26	49	Silt.
1048	G	"	1453	1558	33°31.2'	08°20.5'	30	57	Silt.
1049	GC/WB	"	1512	1540	33°32.2'	08°21.6'	36	68	3'4" core silt.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
1050	G	2.2.69	1600	1607	33°33.6'	08°22.6'	46	87	Silt.
1051	G	"	1619	1628	33°34.4'	08°23.5'	52	98	Mud.
1052	G	"	1643	1653	33°35.8'	08°24.3'	58	109	7'2" brown mud top, silt bottom.
1053	G	"	1706	1711	33°36.8'	08°25.4'	64	121	Mud.
1054	G	"	1734	1747	33°38'	08°26.5'	70	132	Mud.
1055	GC	"	1758	1808	33°39.1'	08°27.4'	73	138	Sandy limestone blocked barrel.
1056	RD/PD	"	1826	1846	33°40.8'	08°28.4'	81	153	Phosphatic? limestone and shell sand.
1057	G	"	1900	1917	33°41.7'	08°29.2'	86	162	Shell sand.
1058	RD/PD	"	1930	1957	33°42.7'	08°30'	100	188	Shell sand.
1059	G	"	2027	2036	33°44.9'	08°31.1'	140	264	Shell sand.
1060	RD/PD	"	2055	2117	33°45.3'	08°32.3'	200	377	No sample.
1061	GC	"	2144	2158	33°47.4'	08°33.9'	278	525	2'9" brown mud.
1062	GC/WB	"	2219	2325	33°48.9'	08°35.1'	346	652	4'0" brown mud.
TRAVERSE 18									
1063	G	3.2.69	0423	0430	33°40'	07°42.7'	26	49	Fine sand.
1064	RD/PD	"	0458	0517	33°41.2'	07°44.2'	34	64	Sticky mud and shelly sand.
1065	G	"	0530	0538	33°42.8'	07°45.8'	42	79	Mud.
1066	G	"	0557	0604	33°44.8'	07°47.1'	51	96	Mud.
1067	G	"	0614	0622	33°46.1'	07°47.8'	55	104	Mud.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
1068	G	3.2.69	0640	0645	33°47.9'	07°49.4'	61	115	Mud.
1069	G	"	0712	0718	33°50.9'	07°51.8'	65	122	Mud.
1070	RD/PD	"	0740	0800	33°53.2'	07°53.8'	70	132	Mud and limestone.
1071	G	"	0836	0847	33°54.8'	07°54.8'	73	138	Muddy sand.
1072	RD/PD	"	0907	0924	33°56.7'	07°55.8'	80	151	Muddy sand.
1073	RD/PD	"	0935	0958	33°58'	07°56.6'	84	158	Muddy sand.
1074	RD/PD	"	1010	1038	33°59.1'	07°57.8'	104	196	No sample.
1075	GC	"	1103	1116	33°59.2'	07°59.3'	134	247	6" core sandy mud.
1076	RD/PD	"	1153	1214	34°02.1'	08°01.6'	270	514	No sample.
1077	GC	"	1223	1245	34°02.7'	08°02.5'	250	471	11" core sandy mud.
1078	RD/PD	"	1310	1336	34°04.8'	08°03.6'	303	571	Brown medium sand.
TRAVERSE 19									
1079	G	3.2.69	1955	1958	33°53.3'	07°06.1'	20	38	Fine sand.
1080	RD/PD	"	2030	2046	33°55.1'	07°05.5'	28	53	Fine sand.
1081	G	"	2053	2108	33°56.5'	07°05.0'	40	75	Mud.
1082	GC	"	2120	2138	33°57.7'	07°06.5'	45	85	Mud (6'11" core).
1083	G	"	2149	2157	33°59.5'	07°07.6'	55	104	Mud.
1084	RD/PD	"	2215	2245	34°01.2'	07°07.5'	58	109	Mud.
1085	G	"	2307	2313	34°03.2'	07°09.5'	64	121	Mud.
1086	G	"	2332	2336	34°06.0'	07°10.3'	70	132	Mud.
1087	G	"	2351	2357	34°06.8'	07°11.0'	68	128	Mud.

Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth UCF	Range CM	Comments
1088	G	4.2.69	0010	0025	34°08.6'	07°11.0'	76	143	Mud.
1089	GC	"	0038	0051	34°10'	07°11.7'	76	143	Mud (1'8" core).
1090	RD/PD/G	"	0114	0145	34°12.8'	07°12.3'	126	237	Fine sand.
1091	PM	"	0155	0905					Magn. and PDR fish recovered.
TRAVERSE 20									
1092	CSP	5.2.69	0455	0830	37°12.3'	08°54.7'			
1093	RD/PD	"	0908	0937	37°12.4'	09°18.2'	260	490	Sand. Mn encrusted volcanic(?) rocks.
1094	RD/PD	"	0953	1025	37°12.9'	09°15'	208	392	Shelly sand.
1095	RD/PD	"	1043	1100	37°13.3'	09°12.4'	86	162	Sand.
1096	GC	"	1118	1136	37°12.9'	09°10.25'	360	678	4" core. Coarse shelly sand.
1097	RD/PD	"	1150	1215	37°12.8'	09°08.8'	204	384	No sample.
1098	G	"	1240	1248	37°12.9'	09°06.8'	84	158	Medium-coarse, green shelly sand.
1099	G	"	1303	1312	37°12.9'	09°05'	72	136	Coarse shelly sand.
1100	RD/PD	"	1327	1345	37°12.5'	09°03.3'	58	109	Coarse shelly sand and Mn coated rock.
1101	G	"	1356	1400	37°12.5'	09°01.5'	56	105	Sand and fresh fractured slate fragments.
1102	RD/PD	"	1413	1437	37°12.4'	09°00.9'	52	98	Coarse shelly sand. Slate and quartzite.
1103	RD/PD	"	1452	1507	37°12.4'	09°00.4'	48	90	No sample.

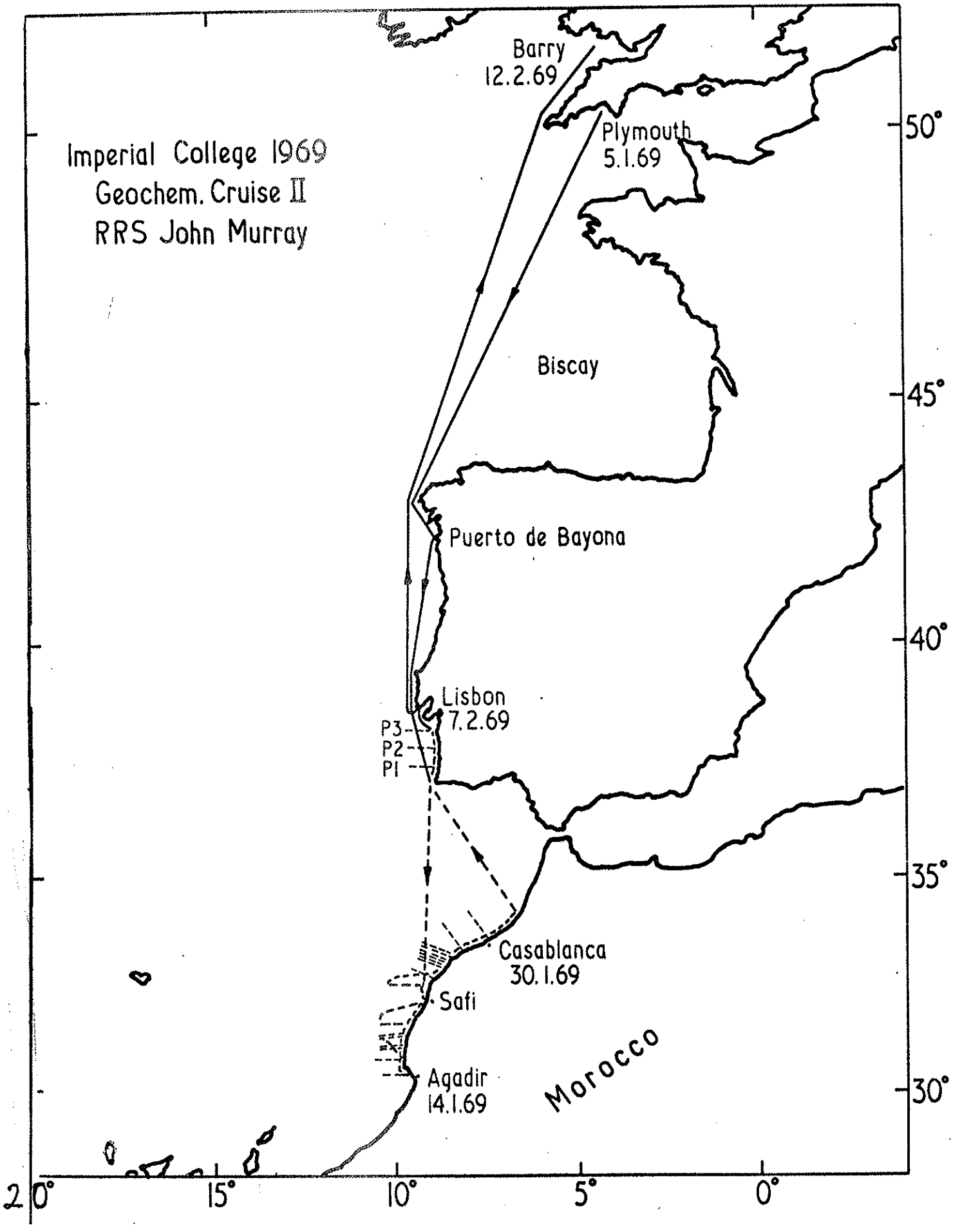
Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth UCF	Range CM	Comments
1104	RD/PD	5.2.69	1531	1545	37°12.2'	08°58.3'	30	57	No sample.
1105	RD/PD	"	1600	1615	37°12.3'	08°57.5'	24	45	Coarse shelly sand.
1106	G	"	1629	1634	37°12.3'	08°55'	23	43	Coarse sand.
TRAVERSE 21									
1107	CSP/PM	5.2.69	1955	2359	37°35.7'	08°49.8'			
1108	GC	6.2.69	0106	0122	37°35.8'	09°14.2'	296	558	5" core green muddy sand.
1109	RD/PD	"	0139	0205	37°35.5'	09°11.8'	260	490	Green muddy fine sand.
1110	GC	"	0215	0240	37°35.8'	09°10.5'	231	435	13" core. Glauconitic green sand.
1111	G	"	0250	0258	37°35.9'	09°09.4'	213	401	Fine green sand, black glauconitic sand.
1112	G	"	0312	0324	37°36'	09°07.6'	190	358	Fine green sand, black glauconitic sand.
1113	G	"	0336	0400	37°36'	09°06.5'	172	324	Fine green sand, black glauconitic sand.
1114	G	"	0412	0421	37°35,8'	09°04.8'	160	301	Fine green sand, black glauconitic sand.
1115	RD/PD	"	0444	0458	37°35.8'	09°02.4'	108	203	Glauconitic shelly sand and limestone.
1116	RD/PD	"	0514	0536	37°35.7'	09°01.2'	88	166	Glauconitic sand. Sandstone, mudstone and limestone.
1117	G	"	0544	0555	37°36.1'	08°59.8'	90	170	Glauconitic sand.

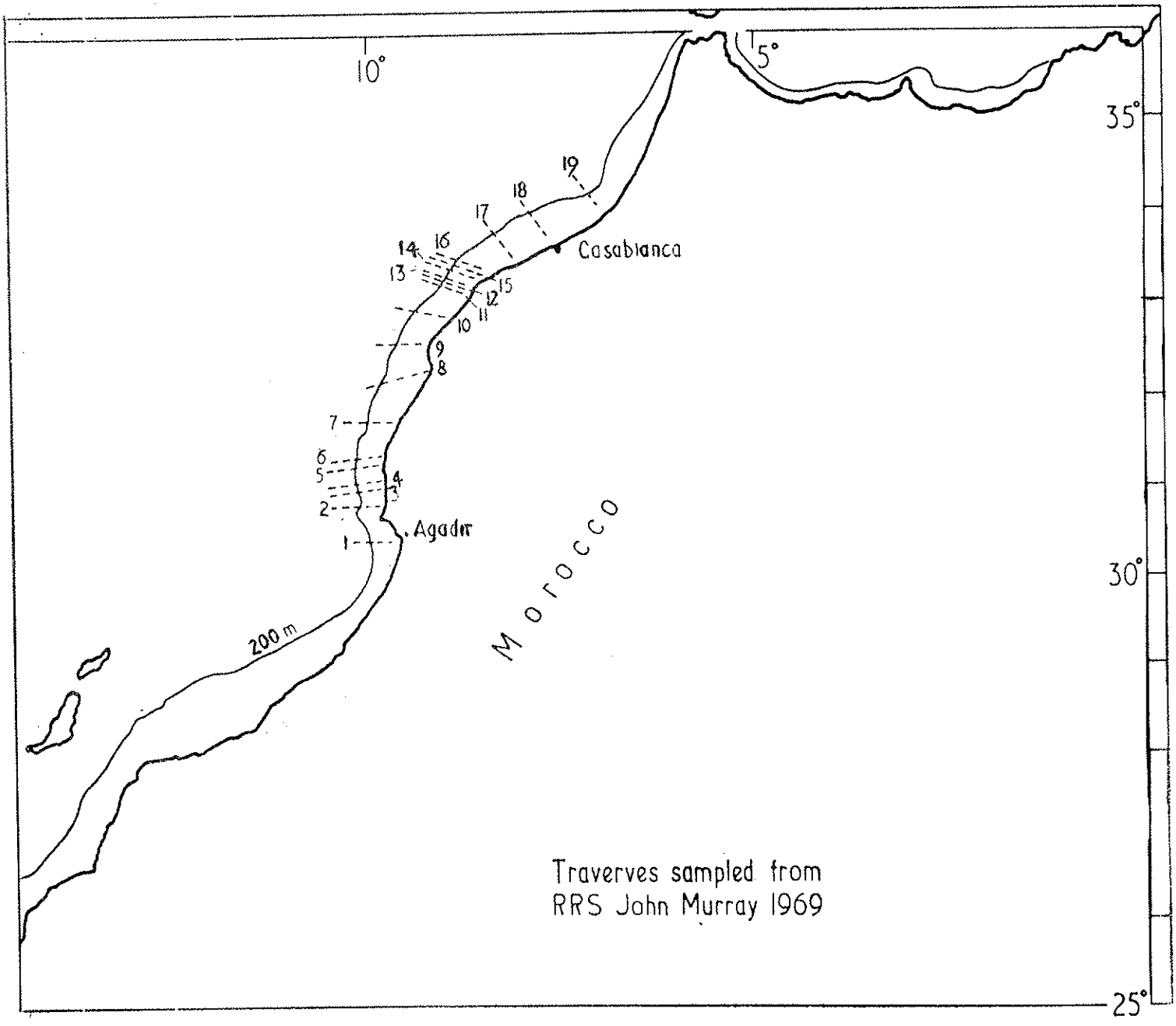
Station No.	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
1118	G	6.2.69	0603	0609	37°35.8'	08°58.3'	83	156	Glauconitic sand.
1119	G	"	0620	0626	37°36'	08°57.1'	76	143	Glauconitic sand.
1120	G	"	0639	0645	37°36'	08°55.3'	69	130	Glauconitic sand.
1121	G	"	0654	0700	37°35.8'	08°54.1'	65	122	Glauconitic sand.
1122	G	"	0712	0722	37°36.1'	08°52.3'	55	104	Glauconitic sand.
1123	G	"	0730	0734	37°35.7'	08°51.4'	48	90	Shell sand.
1124	RD/PD	"	0743	0759	37°35.8'	08°50.3'	28	53	Algal crust. Pipe dredge lost.
TRAVERSE 22									
1125	CSP/PM	6.2.69	1200	1545	37°59.8'	08°52.4'			
1126	GC	"	1627	1644	37°59.7'	09°18.3'	390	735	17" core. Muddy green sand. Overlying 1½" gravel.
1127	GC	"	1723	1748	37°59.8'	09°11.3'	292	550	21" core. Muddy green sand.
1128	GC	"	1822	1836	38°00.2'	09°08.3'	210	396	14" core. Glauconitic sand.
1129	G	"	1900	1909	38°00.1'	09°05.2'	160	196	Glauconitic sand.
1130	RD/PD	"	1928	1944		09°02.6'	104	196	Coarse greenish sand.
1131	G	"	1952	1959	38°00.5'	09°00.8'	82	154	Green shelly sand.

Station No	Type	Date	Time GMT from	to	Lat N	Long W	Depth Range UCF	CM	Comments
1132	G	6.2.69	2018	2028	38°00.3'	08°58.6'	72	136	Shelly muddy sand.
1133	RD/PD	"	2044	2100	38°00.2'	08°57.3'	68	128	Shelly sand.
1134	RD/PD	"	2108	2124	38°00.2'	08°56.6'	60	113	Very coarse shelly sand.
1135	G	"	2140	2145	38°00'	08°54'	36	68	Shelly gravel.
1136	G	"	2157	2201	38°00'	08°52.5'	20	38	Shelly gravel.

Abbreviations

PM	Magnetometer	RD	Rock Dredge
CSP	Continuous Seismic Profile	PD	Pipe Dredge
RAC	Radioactive Counting	GC	Gravity Corer
G	Grab	WB	Water Bottle


Imperial College 1969
Geochem. Cruise II
RRS John Murray
Barry
12.2.69
Plymouth
5.1.69
Biscay
Puerto de Bayona
Lisbon
7.2.69
P3
P2
P1
Casablanca
30.1.69
Safi
Agadir
14.1.69
Morocco
50°
45°
40°
35°
30°
20°
15°
10°
5°
0°


10°
5°
35°
30°
25°
Casablanca
Agadir
MOROCCO
200 m
1
2
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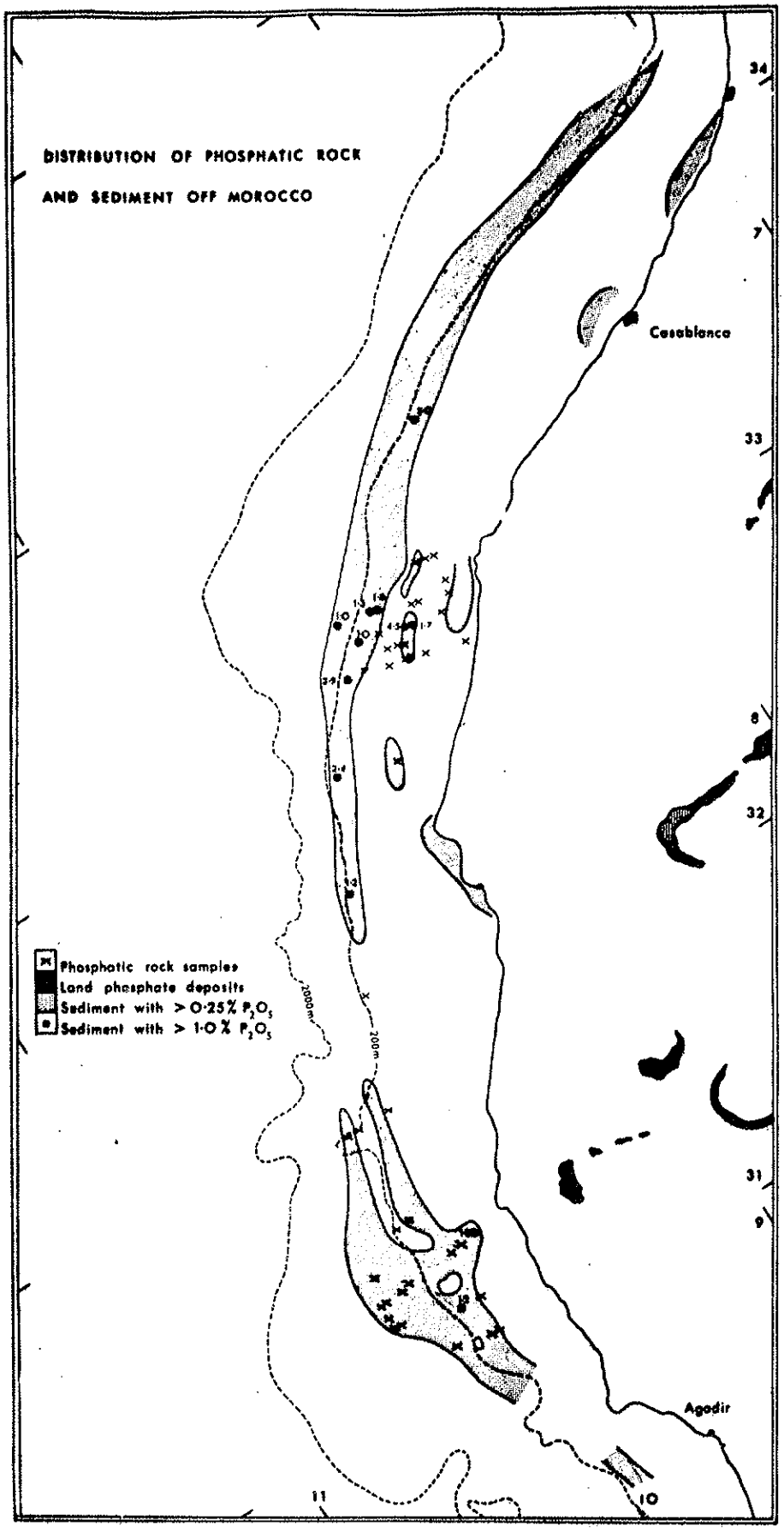
19
Traverves sampled from
RRS John Murray 1969


DISTRIBUTION OF PHOSPHATIC ROCK
AND SEDIMENT OFF MOROCCO
Casablanca
Agadir
34
7
33
8
32
31
9
10
11
Phosphatic rock samples
Land phosphate deposits
Sediment with > 0·25% P_2O_5
Sediment with > 1·0 % P_2O_5
200m
2000m