

Department of Geodesy & Geophysics
Cambridge University

R. R. S. JOHN MURRAY
REPORT ON CRUISE 4/70
APRIL-MAY 1970

N.E. Atlantic.

GEOPHYSICAL CRUISE TO BISCAY

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DATES

Leg (1)	Sailed from Barry	p. m.	23rd April
	Arrived La Pallice	a. m.	6th May
Leg (2)	Sailed from La Pallice	p. m.	9th May
	Arrived Barry	p. m.	20th May

SCIENTIFIC PERSONNEL

Dr F. Gray	(Cambridge)	Leg (1)	Leg (2)
Mr M. Bacon	"	"	"
Mr A. Ziolkowski	"	"	"
Mr W. Q. Limond	"	"	
Mr T. Vertue	"	"	"
Mr M. Mason	"	"	"
R. Donatien	(I. F. P. France)		"
J. Piriou	"	"	"

CRUISE INTENTIONS

The purpose of this cruise was (a) to carry out a gravity survey in the SE. corner of the Bay of Biscay to complete the gravity coverage of the Biscay area. The gravity traverses, obtained during leg (1) are shown on the track chart

(b) to reverse a refraction line previously shot on JOHN MURRAY Cruise 11/68.

(c) to carry out a two ship seismic experiment with the FLORENCE, a survey vessel owned and operated by the Institut Francais du Petrole, France.

(d) to test a Lamont type airgun modified for electrical firing and to carry out a controlled seismic reflection profile with airgun over a reversed refraction line, monitoring depth and pressure of gun and depth of streamer.

NARRATIVE

Leg (1). The sailing date, originally fixed for 6 p.m. on the 21st April was delayed due to bad weather. During that time we carried out modifications to a new winch supplied by the R. V. U. for our Flexotir streamer. While under way to the survey area, the Sperry automatic pilot stopped working and it was decided to make for La Rochelle where a Sperry agent would be available to make repairs. During the two days at La Rochelle we made contact with Mr J. P. Fail of the I. F. P. and had discussions about the joint project which was to take place on leg (2). Also I. F. P. took the opportunity to fit a V. H. F. transceiver in the JOHN MURRAY to be used for ship to ship communications during leg (2). The next five days were spent in carrying out the gravity survey shown on the track chart, in almost perfect weather. As we had time in hand we decided to reverse line B of JOHN MURRAY cruise 11/68 (see cruise report). We started laying the buoys (free floating) at 1952 on the 3rd May and the line was completed and the buoys recovered by 0930 on the 4th. 2300 lb. of geophex was used. During the return journey to La Pallice/Rochelle 28 hours were spent in setting up and testing our airgun system. The airgun consists of a

standard Lamont gun modified by having a solenoid valve fitted so that the gun can be fired electrically.

We found that the solenoid valve used was not sufficiently robust and the gun would not fire consistently. We arrived at La Pallice on the early morning tide of the 6th May.

The four days in La Pallice were used to have discussions with the scientists from I. F. P. about our joint programme. In addition, they fitted the following equipment (in JOHN MURRAY) which they had kindly agreed to lend us.

- (1) A six section flexotir streamer (total length 920 metres)
- (2) A complete seismic digital recording system
- (3) An OMEGA navigation system
- (4) A two way V. H. F. radio system (fitted previously)

Their ship, the FLORENCE is almost identical in size with the JOHN MURRAY and is used mainly for seismic profiling experiments. It is equipped with three flexotir guns, a 24 section streamer (over 2.4 km long) and a complete digital recording system.

The programme decided upon was to be as follows:

- (1) To carry out a common depth point experiment with FLORENCE shooting three flexotir guns and JOHN MURRAY acting as receiving ship.
- (2) To repeat the experiment with JOHN MURRAY firing Aquaseis and FLORENCE receiving.
- (3) To shoot a geophex line with JOHN MURRAY stationary at the mid-point of the previous experiment and FLORENCE receiving.
- (4) To repeat as much as possible of the previous experiments in another location.

It was decided to carry out these experiments in locations where good control was available, and so the first location was to be near line B and the record near a reflection profile previously shot by I. F. P.

Leg (2). We sailed from La Pallice at 2330 hours and headed for a position 10m N. E. of the centre of line B. After laying a Dan buoy (Station 2) some time was spent setting up our systems and testing the communications link. The first experiment began at 1200 hours on the 12th. JOHN MURRAY steamed to the N. W. and FLORENCE to the S. E.

firing three flexotir guns every 40 sec. Both ships were steaming at 10 km/hr and continued until they were 60 km apart.

Timing was accomplished by FLORENCE transmitting a tone break signal which was interrupted when the guns fired. The interrupt started the digital recording system on JOHN MURRAY. It was found that the range of the transmitter was not adequate and after 30 km the signal became noisy but was usable until 50 km. Both ships were towing arrays and FLORENCE continued taking reflection profile records to the end of the line. It was decided that this timing system was unsuitable for the aquaseis experiment and a new system was devised.

Crystal clocks on both ships were synchronised to within $\frac{1}{2}$ sec. Both clocks were recorded on our ship to obtain exact synchronisation before the experiment. The aquaseis was fired manually at pre-determined time intervals to within 1 sec., and the shot instant and clock were recorded at each shot.

The rest of the day was spent in returning to the buoy, having a rendezvous with the scientists from FLORENCE, and testing the modified timing system. The aquaseis experiment began at 1147 hrs on the 13th. Thirty eight shots were fired at $2\frac{1}{2}$ minute intervals and each shot contained $3\frac{1}{2}$ lb. (200 ft) of explosive except the last seven which were 7 lb. (400 ft). The new timing system worked well and all shots were successfully recorded. After the experiment both ships returned to the buoy and it was decided to shoot the geophex line the next day in daylight to give a visual fix on the buoy. Also the TORAN navigation system on the FLORENCE (Similar to HIFIX) operates better in daylight.

Shooting commenced at 0900 hrs on the 14th with JOHN MURRAY steaming at $\frac{1}{2}$ mile radius round the buoy. A total of thirty shots were fired at 8 minute intervals. Timing was the same as in the previous experiment. After recovering the dan buoy a further meeting was held and we decided to move to the second location and in the time available, repeat the aquaseis and geophex experiments. Both ships arrived at the centre of line 009 (Station 3) at 0445 hrs on the 15th and we commenced laying the dan buoy. Unfortunately the anchor wire parted as we were paying out so the buoy was laid free floating just before the geophex shooting started at 0735 hrs. Twenty-

three shots were fired at 10 minute intervals, the buoy was recovered and the final run took place with JOHN MURRAY steaming SE (120°) at 5.5 kts. firing aquaseis and FLORENCE steaming NW receiving. Forty - one shots of aquaseis were fired, each shot at $1\frac{1}{2}$ minute intervals. A heavy swell developed while we were firing geophex and the aquaseis was fired with difficulty. The violent motion of the ship caused some damage to the array on board the FLORENCE while it was being recovered. This completed our joint experiment and the FLORENCE steamed off to La Pallice. The rest of the day was spent in setting up the airgun system with the intention of profiling along line 009. This work continued until 0115 on the 17th, but was unsuccessful due to troubles with the towed array. Two active sections of the array developed leaks causing the array to tow incorrectly and generate noise.

The JOHN MURRAY then steamed to La Pallice to return the equipment loaned by I. F. P. and arrived alongside at 0200 hrs on the 18th. All the equipment was removed by 1100 hrs and the JOHN MURRAY sailed for Barry at 1300 hrs arriving alongside on the 20th at 1600 hrs. We would like to thank Capt. Justin, the officers and crew of the JOHN MURRAY for their help and active participation in the scientific work on the ship. We would also like to thank all the personnel from I. F. P. aboard the FLORENCE and the JOHN MURRAY (in particular Mr J. P. Fail the Chief Scientist) for their co-operation and help during the joint experiment.

PROJECT REPORTS

Two ship experiment

The actual experiments have been described in the narrative. This is the first time we have used aquaseis. The firing system, consisting of a Bay Blaster and firing cable were kindly lent to us by I. C. I. The system proved to be reliable and very easy to use. Good refraction arrivals were received at 32 km with only 6 lb of aquaseis. This is partly due to the efficiency of the aquaseis, but is also due to the ease with which arrivals can be identified when 24 traces are recorded individually from a 2.4 km array. The same is true for the geophex

experiment. It appears that 20 lb. charges would have been adequate at a range of 40 km, whereas, using sonobuoys we need at least 100 lb. of geophex. The use of digital recording systems will enable us to use array processing techniques and enhance the quality of the records.

Streamer winch

A new winch designed for towed seismic arrays was completed and installed by the R. V. U. on board the JOHN MURRAY just before sailing. The drum is 4 ft. in diameter and 4 ft. wide with side flanges 8 ft. in diameter. It is capable of holding a 12 section flexotir array. The drive system used a 5 H. P. three phase motor coupled to a 60:1 reduction worm drive, with a chain drive to the drum shaft.

The winch worked extremely well and the array could be handled with ease. It was found however that when the array was fully steamed and the motor switched off, the tongue of the drum was sufficient to keep the motor running, so that a brake system had to be fitted. This was arranged while we were at La Pallice and the brake was effective.

Profiling system

The troubles experienced with the airgun system have been described in the narrative. An important aspect of this work relates to the monitoring of the parameters associated with the airgun system such as depth and pressure of gun and depth of streamer. It is necessary to maintain these variables constant to within close tolerances to control the reproducibility of the signal. The depth of gun was maintained to within ± 1 ft. and the pressure to ± 50 lb/sq. in., which is well within acceptable error. Normally the array depth can be maintained to within ± 2 ft. but on this occasion this was unsuccessful.

Gravity

Gravity was measured using the Cambridge Askania gravimeter and cross-coupling computer. Owing to a fault in the gravimeter circuitry no gravity was measured between Barry and La Rochelle; otherwise the meter worked well apart from a few hours' loss of platform stability due to a fault in the servo amplifier circuit. Calibration was carried out in the La Rochelle at the beginning and end of the survey, which was tied to a base station at La Pallice.

Sonobuoys

The system used was that of JOHN MURRAY cruise 11/68 and described in the report of that cruise. Minor troubles with the radio receivers meant that arrivals were not received over the radio from one buoy: one of the buoys had a hydrophone noisy at low frequencies; otherwise the system worked well

DISTRIBUTION

N. E. R. C. London

N. E. R. C. Barry

Master, R. R. S. JOHN MURRAY

Bosun, R. R. S. JOHN MURRAY

Dr A. S. Laughton (N. I. O.)

Prof. D. H. Griffiths (Birmingham)

Prof. M. H. P. Bott (Durham)

Dr J. S. Tooms (Imperial College)

Sir Edward Bullard (Cambridge)

Dr D. H. Matthews

L. H. Flavill

Dr F. Gray

M. Bacon

A. Ziolkowski

W. Q. Limond

T. Vertue

M. Mason

J. P. Fail (I. F. P. France)

R. Donatien (I. F. P. France)

L. Montadert (I. F. P. France)

STATION SUMMARY

Stn. No.	Date	Position of Stn.	Length of line (Km)	Steaming Direction of	Type of Explosive	No. and Wt. of Shots	Total No. of Shots	Total Wt. of explosive used (lb)	Comments
(1)	3 May	45° 59' 6° 47'	70	127° -	Geophex	6 x 25 lb. 3 x 50 lb. 4 x 100 lb. 5 x 200 lb. 3 x 300 lb.	20	2300 lb.	Refraction, using sono-buoys line B.
(2)a	12 May	45° 52' 6° 09'	60	305° 125°	Flexotir	270 x 6 oz.	270	100 lb.	Common depth point. Florence shooting.
(2)b	13 May	do do	32	305° 125°	Aquaseis	31 x 3 lb. 7 x 6 lb.	38	135 lb.	Common depth point. John Murray shooting.
(2)c	14 May	do do	40	- 125°	Geophex	21 x 20 lb. 2 x 40 lb. 7 x 50 lb.	30	850 lb.	Reflections into refraction. John Murray shooting.
(3)a	15 May	45° 10' 04° 28'	40	- 300°	Geophex	11 x 20 lb. 5 x 40 lb. 7 x 50 lb.	23	770 lb.	Line 009 as at 2(c)
(3)b	15 May	do do	11	120° 300°	Aquaseis	41 x 3 lb.	41	123 lb.	as at (2)b



