DEPARTMENT OF GEODESY & GEOPHYSICS
CAMBRIDGE UNIVERSITY

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REPORT ON CRUISES 6/71 and 7/71

OCT-NOV 1971

Mediterranean

GEOPHYSICAL CRUISE IN THE EASTERN MEDITERRANEAN

CONTENTS

DATES

Leg. 1: Sailed from Naples p.m. 9th October
Arrived Famagusta p.m. 20th October

Leg. 2: Sailed Famagusta a.m. 23rd October
Arrived Suda Bay (Crete) p.m. 9th October

SCIENTIFIC PERSONNEL

F. Gray	Cambridge	Leg 1	Leg 2
A.P. Stacey	"	"	
H.A. Allerton	"	"	
D. Sewart	"	"	
J. Lort	"	"	"
S. Smith	"	"	"
W.Q. Limond	"	"	"
T. Vertue	"	"	"
M. Mason	"	"	"
G.L. White	"	"	"
S. Jones	R.V.B.	"	"
A. Horowitz	Imperial College		"
Research student	" "		"

CRUISE INTENTIONS

The purpose of this cruise was:

(a) To carry out seismic refraction experiments, seismic profiling, and magnetic surveys in order to determine the nature of the crust in the Eastern Mediterranean;

(b) To carry out on behalf of Imperial College a coring and dredging programme south of Crete for the last five days.

NARRATIVE

Leg 1 (Cruise 6/71)

During this leg, four refraction lines were shot one way. These were R_1 (89 miles), R_4 (78 miles), R_6 (68 miles) and R_7 (70 miles) and their positions are shown on the accompanying map. In addition, all the lines were profiled by airgun except R_7 which was abandoned because of compressor troubles until the next leg. The magnetometer was towed along all refraction lines and on passage between lines. On passage to R_1 the airgun profiling system was tested and the depth sensor in the streamer was calibrated (this should be carried out at least once during every cruise). In addition the aquaseis firing system was tested and some modifications were made to the firing clock to prevent resetting. The automatic steering system failed on 11.10.71. and was out of action for four hours. R_1 was shot on the night of 12th/13th October and 3180 lbs of geophex used. Poor arrivals were obtained on this line and the highest velocity obtained was 5.8 km/sec at a depth of 11.2 km. After profiling along R_1, the 16 hours steaming to R_4 was utilised to try to repair a leak in one of the streamer sections and refill it with oil. At R_4 during the profiling which preceded the refraction, serious faults developed in the compressor and it never functioned satisfactorily during the remainder of the cruise in spite of continuous attention by some of the scientists. R_4 was shot during the night of 15th/16th October and 3130 lbs of geophex was used. Arrivals on this line were better than those on R_1, but again no Moho arrivals were detected, the highest velocity being 6.5 km/sec at a depth of 17 km.

R_6 which was close to R_4 was shot on the following night (i.e. 16th/17th October) and 3130 lbs of geophex was again used. Arrivals were disappointing as before, and it was clear that larger charges would have to be used. The highest velocity obtained was 4.8 km/sec at a depth of 15.6 km. Profiling was carried out along the line and

then on course for R_7 but this was frequently held up due to faults in the compressor. These faults included diesel, cooling system, and mechanical failures in all stages of the compressor.

While on course for R_7 the spring section of the streamer was found to have a hole in the plastic near the towing head. A small section of the plastic tube was removed, the end was remade and the tube refilled with oil.

R_7 was shot during the night of 18th/19th and 3130 lbs of geophex used. This line was near the northern edge of the Nile Cone and considerable thickness of sediment was obtained. Arrivals were good but again no Moho arrivals, and the maximum velocity obtained was 6.4 km/sec at a depth of 17.5 km. It was decided to abandon any further attempts to keep the compressor working and to make for Cyprus in order to (a) make sure that permission had been obtained to work on the Cyprus shelf;

(b) have repairs carried out on the compressor, and

(c) have modifications carried out on the firing platform so that larger charges could be fired (See Geophex).

Arrived in Famagusta p.m. on the 20th October. While in Famagusta we contacted the local R.A.F. base and they kindly agreed to ship our computer container and its generator on one of their transport ships back to the U.K. free of charge. The container and generator were transferred to an R.F.A. ship in Famagusta on October 23rd.

Leg 2 (Cruise 7/71)

During this leg the following Cambridge work was carried out:

(1) Two short reversed refraction lines X and Y in Famagusta Bay (13 miles) and Morphou Bay (11.5 miles);

(2) Two grid surveys, G (270 miles) and H (150 miles) shown on map with profiling and magnetics;

(3) R_7 reversed (60 miles) and profiling using sparker;

(4) R_6 reversed (70 miles);

(5) R_4 reversed (73 miles);

(6) Along 35 miles of R_4 an experiment to obtain wide angle reflections from deep horizons. This involved shooting over 200 shots of aquaseis and geophex, one shot every 2 minutes. Two disposable sonobuoys were used on this line and another used on grid survey H.

(7) A two ship refraction experiment was attempted in Famagusta Bay, but this was abandoned after a few shots because of loss of synchronisation of clocks (see Two Ship Refraction).

Researcher sailed from Famagusta at 0900 hrs on the 23rd and the two ship experiment was undertaken in perfect weather. This was immediately followed by refraction on line X using the Bradley buoys and the line was shot one way before dark. It was then necessary to return to Famagusta to off load the Computer container and its generator, to pick up the two scientists from Imperial College and to sign on a replacement for our cook who had left the ship without permission on our previous visit.

Line X was reversed the following morning and we steamed round to Morphou Bay to shoot line Y. Some rough weather was encountered on passage and the ship slowed to 8 kts. Line Y was completed by 0015 hrs on the 26th. Good arrivals were obtained on both lines X and Y.

Grid survey G was then carried out. This consisted of 4 lines 60 miles long at 10 mile spacing, and bathymetry, profiling and magnetics were recorded. Half way through the survey it was decided to abandon our attempts to keep the compressor going. The 3 scientists working on it had managed to have 5 hours sleep in 2 days. The sparker was substituted, and using the flexotir array reasonable records were obtained in perfect weather conditions. On our way to survey H some tests were carried out to see if it was possible to fire geophex using aquaseis as primer. The tests were as follows:

(1) Detonator with slow burning fuse was taped to 50 ft of aquaseis and the other end of the aquaseis was taped to 5 lbs of geophex. This detonated successfully.

(2) As before, but two charges of 5 lb were taped to the aquaseis 20 ft apart. The charges were buoyed and both detonated simultaneously.

(3) 25 lb of geophex was suspended on 150 ft of aquaseis and the detonator end was buoyed. This also fired successfully. These tests showed that it would be possible to detonate simultaneously several charges of geophex which were linked by aquaseis.

Grid survey H was started on the 30th October and sparker was again used for profiling. On the 31st the P.D.R. fish stopped working and the O.R.E. fish was substituted, until the P.D.R. fish could be repaired.

R_7 was reversed during the night of the 1st/2nd November and prior to this the line was profiled using sparker.

As refraction arrivals during the first leg were poor, it was decided that we should concentrate all the remaining explosives in reversing R_7, R_6 and R_4 as these had produced the best arrivals. This meant that we would have to fire larger charges (i.e. up to 1100 lbs) at the ends of the lines (see Geophex). A total of 3985 lbs of geophex was fired successfully. During this run we attempted to buoy 2 charges but both misfired and we presume that when the weight was taken on the buoy the plastic banding around the charge gave way and the charge broke up. R_6 was reversed on the night of 3rd/4th November and 4525 lbs of geophex was used. The technique of firing large charges was now established and no difficulties were experienced in firing charges of up to 1050 lbs while reversing R_4. Much stronger arrivals were obtained with the larger charges on all the reversed lines, but only on R_7 were Moho arrivals obtained. This gave the depth to the Moho of 28.3 km and the velocity was 8.4 km/sec. The buoys were recovered and while the batteries were being recharged for the wide angle experiment at R_4 a P.D.R. survey was carried out to establish a good site for this experiment. The buoys were relaid and we steamed 10 miles beyond the buoys, turned, streamed the array and started shooting aquaseis just before passing the buoys. 203 shots were fired, one shot every 2 minutes. The array stopped working 14 shots from the end of the experiment and on the last shot the stainless steel sphere attached to the end of the firing cable came off. The experiment ended at midnight on the 6th November and this ended the work of the Cambridge group.

The remainder of the cruise was spent in carrying out a programme of profiling and coring along 2 lines running from the south coast of Crete in a southeast direction. As the flexotir array was not working a spare Cambridge array was tried and was found to be superior in performance to the sparker array.

After a good deal of difficulty, mainly due to the fact that the splice on the 6 mm wire would not go through the metering sheave, penetration with corer was achieved on 8th October. However, as the metering sheave had been removed there was no accurate way of determining when the pinger on the wire would break surface. The brake was not applied quickly enough and the pinger jammed in the snatch block breaking the wire, and the corer and pinger were lost.

Further attempts at coring proved unsuccessful and Mr. Horowitz advised that we abandon this work until modifications had been made to the winch. We arrived at Suda Bay, Crete, on the afternoon of the 9th November.

We would like to thank Captain Smith, the officers and crew of Researcher for their help and participation in the scientific work on the ship.

PROJECT REPORTS

(1) Geophex

As described in the Narrative, it was found necessary to fire charges of up to 1050 lbs on leg 2. For this purpose it was necessary to have a platform which could be tipped up. The fixed platform was fitted with a swivel at its mid point and it was moved so that it faced directly aft. This work was carried out during our stay in Famagusta. It is our normal practice to fire up to 400 lbs of geophex assembled in 1 block and so 3 charges were assembled on the platform. These were then linked by attaching 2 x 50 ft lengths of aquaflex between the charges, then 150 ft of aquaflex was attached to the charge furthest inboard. To the other end of this was attached a detonator complete with 6 ft of slow burning fuse and a small polystyrene float was attached to the detonator. The long length of slow burning fuse is necessary to delay the detonation by 2 minutes. The buoy delays the sinking of detonator and so it is not extinguished by being at too great a depth at detonation time. After some initial misfires 7 such multiple charges were successfully fired by this method.

(2) Two Ship Refraction

Along refraction line X in Famagusta Bay it was decided to try to repeat the conventional sonobuoy experiment using a 26 ft motor launch hired in Famagusta as a firing ship, shooting 24 shots of aquaflex at 5 minute intervals. The motor launch came alongside Researcher 5 miles southeast of Famagusta harbour and each ship was fitted with identical clocks which were then synchronised. The clock in the launch was to fire an aquaflex charge every 5 minutes and the clock on Researcher was to provide the timing of the arrivals. Three shots were fired and successfully received on Researcher but due to earthing problems in the launch, the firing clock reset and

the experiment was abandoned. However, it was shown that it is feasible to fire aquaflex charges from a small boat, provided that the weather is satisfactory.

(3) Compressor

A total of 60 hours were spent in repairing 21 breakdowns on the compressor, and eventually profiling by airgun was abandoned as the effort required to keep the compressor going was too great.

(4) P.D.R.

The P.D.R. broke down on 31.10.71. and although considerable efforts were made to try to repair it, it did not function satisfactorily again.

(5) Geomechanique Streamer

The streamer performed satisfactorily until the end of the wide angle experiment, apart from minor repairs to the plastic cover being necessary. The streamer winch worked well but the streamer was slightly difficult to handle because the winch was mounted on the top deck, and this resulted in the minor damage. The final failure was due to all the wires in the towing cable becoming open circuited.

(6) Wide Angle Experiment

This has been described in the Narrative. However, we have shown that it is possible to do such an experiment using one ship and sonobuoys although the results are inferior to those that would be obtained using two ships. This is mainly due to the fact that the sonobuoy hydrophones are much noisier than a towed array (i.e. 4 transducers in 4 sonobuoys as opposed to 360 transducers in a 4-section streamer) and the recording system is less satisfactory.

(7) Computer and Data Logger

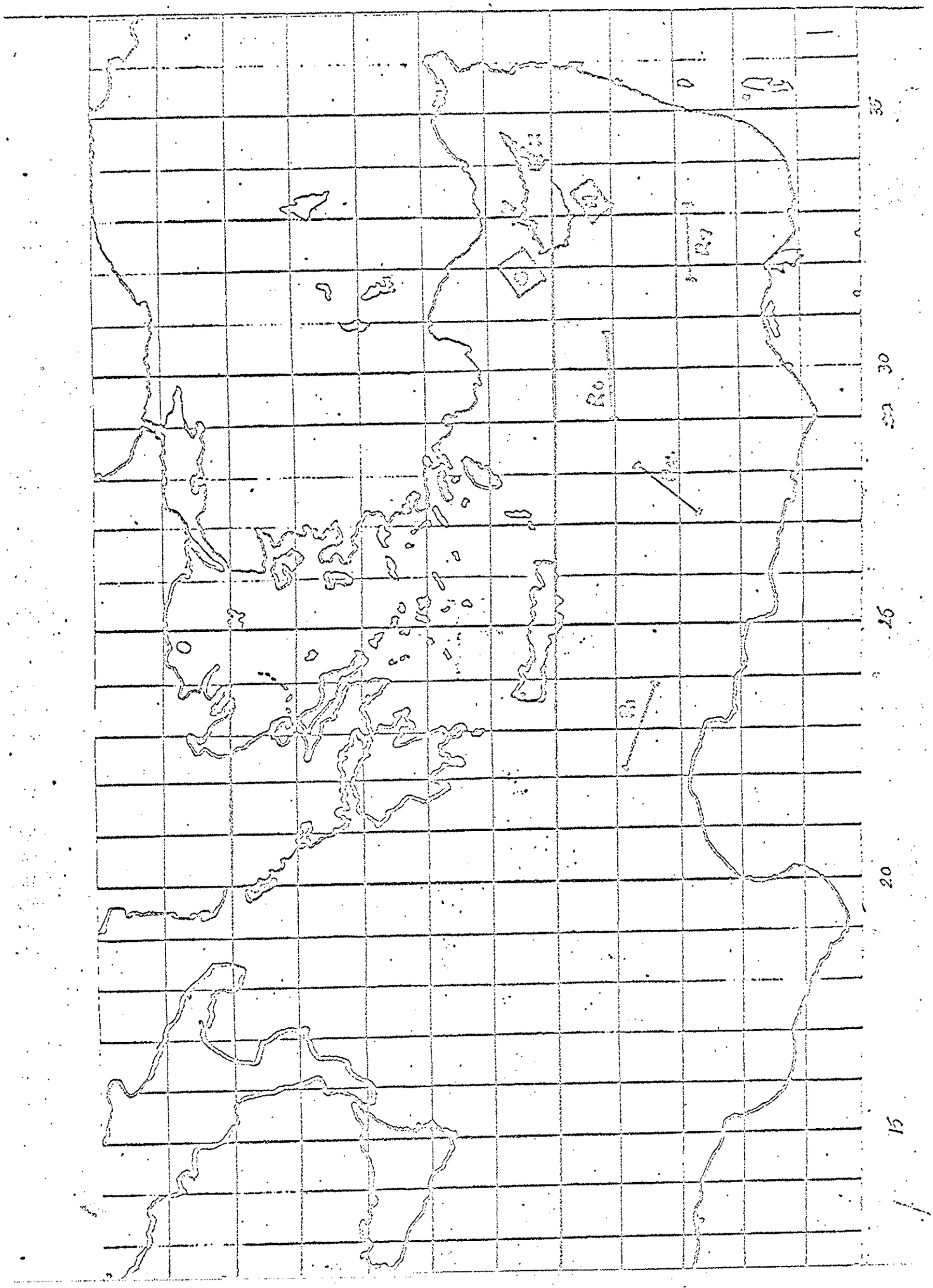
During the first leg of this cruise an I.B.M. 1130 computer installed in a container and a data logger jointly developed by Cambridge and Decca Ltd were used. The system was installed mainly for testing purposes and magnetics and navigational systems were logged. The system has been described elsewhere. Both logger and computer worked well the only breakdown being the computer typewriter and this was repaired by I.B.M. engineers in Famagusta.

STATION SUMMARY

Line	Date	Posn. of Line Lat. °N	Long. °E	Length (nm)	Dirn.	Explosive	No. & Wt. of shots	Total shots	Total weight (lbs)	Comments
R_1	12 Oct	33°04'	22°16'	89	106°	Geophex	3 x 10 2 x 200 2 x 25 4 x 300 2 x 50 3 x 400 2 x 100	18	3180	Refraction with 3 sonobuoys
R_4	16 Oct	32°44'	27°10'	70	223°	Geophex	3 x 10 3 x 20 2 x 25 5 x 300 1 x 50 2 x 400 1 x 100	17	3130	Refraction with 3 sonobuoys
R_6	17 Oct	33°58'	29°04'	70	084°	Geophex	3 x 10 3 x 20 2 x 25 5 x 300 1 x 50 2 x 400 1 x 100	17	3130	Refraction with 3 sonobuoys
R_7	18 Oct	32°57'	31°50'	70	085°	Geophex	3 x 10 3 x 20 2 x 25 5 x 300 1 x 50 2 x 400 1 x 100	17	3130	Refraction with 3 sonobuoys
X	23 Oct	35°11'	34°03'	15	027°	Geophex	6 x 5 4 x 10 4 x 25	14	170	Refraction with 2 sonobuoys
XR	24 Oct	35°20'	34°10'	15	211°	Geophex	6 x 5 5 x 10 1 x 25	12	105	Refraction with 2 sonobuoys to reverse Line X
Y	25 Oct	33°15'	32°45'	10	195°	Geophex	6 x 5 4 x 10	10	70	Refraction with 2 sonobuoys
YR	25/26 Oct	35°25'	32°50'	12	025°	Geophex	6 x 5 6 x 10	12	90	Refraction with 2 sonobuoys to reverse Line Y

Station Summary Cont.

Line	Date	Pos^{n}. of Line Lat. ^{o}N	Long. ^{o}E	Length (nm)	Dir^{n}.	Explosive	No. & Wt. of shots	Total shots	Total weight (lbs)	Comments
R_7R	1 Nov	32°59'	32°23'	57	265°	Geophex Aquaseis	1 x 10 1 x 100 1 x 25 3 x 200 1 x 50 2 x 300 2 x 1000	13	6185	Refraction using 4 sonobuoys to reverse R_7
							1 x 5 + 5 aquaseis (test) 1 x 50 + 50 aquaseis (test) 2 x (400+400+200 aquaflex)			Test methods of firing large charges
R_6R	3 Nov	34°10'	30°35'	80	263°	Geophex	1 x 25 2 x 200 1 x 50 4 x 300 1 x 100 1 x 800 1 x 900 1 x 1050	12	4525	Refraction with 3 buoys to reverse R_6. Large charges.
R_4R	5 Nov	33°35'	28°42'	73	220°	Geophex	1 x 100 2 x 400 1 x 200 1 x 900 2 x 300 2 x 1050	9	4700	Refraction with 3 buoys to reverse R_4. Large charges.
R_4A	6 Nov	33°04'	28°18'	59	218°	Aquaseis	48 x 100', 130 x 200	203		Wide angle reflection and refraction. 4 buoys.
						Geoflex	24 x 300'			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