

INSTITUTE OF GEOLOGICAL SCIENCES
GEOPHYSICAL DIVISION
MARINE GEOPHYSICS UNIT

REPORT NO. 61
PROJECT NO. 75/06
BRENT AREA
CRUISE REPORT 17-30 JULY 1975
MV AQUA STAR

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AIMS

The aims of this cruise were fourfold with the main priority being to carry out a regional shallow seismic survey on a 5km grid between 61°N and 1°E to the median line. The second priority was a detailed area within this grid where 1km grid spacing was to be employed. The information required for this detailed area was in the first 100 metres of sediment. This area was of particular interest to Shell and Esso who had representatives on board for part of the cruise. The other objectives were to collect data along the Brent pipeline from the edge of the 1974 East Shetland survey area (see MGU Report No 54) to the main survey area, and to survey three profiles using the 12 channel digital recording system in an area north of Unst for IGS Hydrocarbon Group.

PARTY CHIEF'S REPORT

During the 10 days of the survey over 1400 km were surveyed. Two days were lost due to adverse weather. During the period of bad weather the ship returned to Lerwick to drop off one Shell and one Esso scientist and to fill up with fresh water. During the first few days, 2 Shell and 1 Esso representative were on board. The first part of the cruise was devoted to the survey over the Brent pipeline and in the detailed area of 1km spacing. For these surveys the Nova Scotia Deep Tow Sparker was run in conjunction with the IGS multi-tip sparker equipment. There was little or no interference between these two types of equipment and the results together gave an excellent geological picture to 100 metres or more. After the completion of this part of the survey one of the Shell geologists left

on Monday evening, 21 July by tug and at the same time a Polytechnic Engineer joined the ship at the request of the Nova Scotia Research Foundation. Later that evening the weather became worse and with gales forecast, the ship sailed for Lerwick.

On leaving Lerwick the three profiles requested by J Chalmers were completed before continuing on the regional survey. Only one further day was lost due to weather and this occurred when a large swell was encountered and the results deteriorated so much, work stopped for 24 hours. The survey was completed by midday Monday, 28 July and the ship sailed for Leith.

This was a pleasant cruise and it was most enjoyable having the Shell, Esso and Polytechnic Engineering visitors on board.

TECHNICIAN I/C's REPORT

The only failures which occurred were small and easily remedied. Three multi spark electrodes were used and two failed after about 3 to 4 days hard work. However, the results were good when they were working correctly. Some minor failures occurred in the Aquatronics power units but were easily remedied by the Aquatronics engineers. There were no failures in the recording equipment.

AQUATRONICS CHIEF ENGINEER'S REPORT

Aquatronics equipment used during this cruise included the following:-

Two 1500 Joule sparker power sources.

A small binomial array streamer.

Edo Western sub bottom profiler.

Atlas echo sounder.

12 trace streamer.

Aquatronics digital acquisition and recording system.

EPC recorders.

Two 40KVA generators.

One of the 1500 Joule sparker units failed on 21 July and a temporary repair was made while in Lerwick on 22 July. IGS survey work was not interrupted.

Problems were encountered with the 40KVA generators which resulted in 1 hours downtime on 23 July. All other equipment functioned well throughout the cruise.

The Aquatronics digital recording system was used on 23, 24 and 27 July and functioned well. Each day, checks were made of streamer leakage, equalisation of channel gain, cross-talk and system noise. Tape transport skew checks were made at the beginning of the IGS contract. All tapes were played back to ensure data had been recorded. Each time the system was used the summing option was "sum two drop one" and the record length was 800mS.

GEOLOGY/GEOPHYSICS REPORT

The most distinctive morphological features found in the main survey area are the channels which occur at many levels within the succession. The channel distribution has been plotted and some inter-line correlations have been made, but it is probable that much closer grid surveys will have to be studied before the channelling is understood. The largest channels are found in the eastern and central parts of the

sheet, being particularly well developed in the Brent area. High level channelling down to c 80m is common only around the Cormorant field.

The deposits may be very broadly sub-divided on the basis of seismic texture into two groups, the lower of which is evenly bedded, tends to be transparent and can be traced laterally for some distance. The upper group shows a dense series of reflectors which are irregular and fade laterally although some are strongly developed. A horizon has been mapped which in the west approximately divides the two textures but which dips below well bedded horizons to the east. This horizon, which is very rarely cut by channelling, is considered to be near the base of the Quaternary. With the use of borehole data provided by Shell it has also been possible to identify the nature of the sediments profiled.

The digital sparker records obtained some 56km west of the main survey area have been interpreted as showing pre-Mesozoic (?Old Red Sandstone and Dalradian), Mesozoic, Tertiary and Quaternary successions. Unfortunately the limited coverage makes any area interpretation uncertain although a geological map has been constructed. It may be significant that the (?) Tertiary/Quaternary succession in the east is very similar to that found at the western end of the main survey area (compare EOL 25 and SOL 39).

A bathymetric map of the sheet has been constructed by N A Ruckley. Excellent crossovers (usually < 1 metre) were obtained and 5m contours have been drawn. The sea bed shows a very gentle relief which deepens gradually north-westwards from 140m to 180m. Immediately to the north-east of the survey area the waters deepen abruptly towards the

Norwegian Trench. A sea bed obstruction was encountered and is to be reported to the appropriate authorities.

NOVA SCOTIA RESEARCH FOUNDATION
DEEP TOW BOTTOM PROFILING SYSTEM

Survey

A total of 24 lines were profiled in about 63 hours on six operational days. The shortest line was about 30 minutes, the longest about 6 hours. Ship track speeds were generally between 4 and 8 knots with most profiling at speeds between 5.5 and 7 knots. Water depths were in the range 140-170 metres. Sea conditions during survey operations with the Deep Towed System varied from calm to moderate wave and swell.

In addition to the above survey work about 4 hours were spent making recordings of noise level, and direct wave at a far hydrophone towed about 33 metres behind the V-fin.

Equipment operation

Deck handling equipment operated satisfactorily except that severe wear of the cable overwrap was noted, caused by the offset between winch and the main sheave. Some improvement was produced by bringing the A-frame back to an inboard position after launching to give improved alignment. A generator stoppage on 25 July was at first attributed to fuel starvation and a separate supply was installed. The problem continued and was finally diagnosed as low oil pressure. An oil change and check for leakage in the high pressure diesel lines cured the problem.

By careful choice of ship's engine RPM relative to the prevailing wind and swell operation at reduced RPM to 100 was possible giving lower track speeds of 5.5-6.5 knots and improved signal to noise. To avoid possible engine stoppage in turns, all major turns were made after increasing ship RPM to half speed.

The processing equipment performed satisfactorily. The use of a second graphic recorder reduced down time due to paper or stylus belt changes and allowed the simultaneous display of two records representing alternate sweep speeds, transducers or filter pass bands. Magnetic tape records again provided back up for the graphic recorders.

Experimental tungsten electrodes for the Teledyne High Voltage Supplies developed in previous cruise (MGU project 75/07) continued to give satisfactory service, reducing the need for adjustment and servicing required to give adequate triggering for high resolution.

Performance

The harder bottom conditions prevalent in the northern North Sea resulted in generally reduced penetration of about 10-50 msec depending on sub-bottom character. Resolution was generally about 1-2msec.

Compatibility with other profiling systems

The Deep Towed Sparker System was operated at various times with Atlas Deso Echo Sounder, Edo Western Pinger, Multi Electrode Surface Towed Sparker, Digital Surface Towed Sparker. Cross-talk and spurious triggering were negligible, while overprinting of records was minimised by careful phasing of the various EPC recorders.

CHIEF SURVEYOR'S REPORT

Position Fixing

The principal method of fixing was by Decca Main Chain OE (Vestlandet/Bergen). The IGS Sat/Nav system was interfaced to the same chain as a source of dead-reckoning information and was operated as a supplementary positioning system. The operation of the Sat/Nav system is discussed later. In operational terms the system was used to provide continuous information of position and course relative to the line being steered but was not used to provide absolute positions owing to accuracy uncertainties.

Main Chain OE proved remarkably stable and consistent throughout the period and survey area. A transmission fault on the red pattern caused a cessation of survey operations from 1205 to 1320 on 20 July 1975. Otherwise no trouble was experienced. Over most of the survey area a correction of +0.15 lanes was applied to the green pattern. This was done on the advice of Shell as a result of their monitoring of the chain against other positioning systems in the area and with the intention of providing consistency with previous surveys and drilling operations. This correction was applied to all lines except the first part of line 1 which was uncorrected in order to provide consistency with IGS project 74/04.

On two occasions, at the request of Shell, Hordaland Hi-fix was set up using the geographicals to Hi-fix section of program HP 11. This data was recorded on the Decca Printlog but not utilised in the field owing to a lack of lattice charts.

Position fixes on this project should be regarded as accurate to approximately \pm 100 metres.

Lines Run

A considerable amount of deviation from the pre-planned line programme was necessary owing to the high level of oil activity in the area. However, with a few small areas uncovered, a dense network was run over the area bounded by 61°N , $61^{\circ}30'\text{N}$, 1°E and the British/Norwegian median line. A total of 44 lines were run, of which four were outside the above area. One followed the Cormorant-Shetland pipeline route and the other three were in the area around 61°N , 00°E .

Charts

All lines with the exception of lines 10 to 20 were fair plotted in ink onto standard IGS base sheets at 1:100 000 and 1:250 000 scales. Lines 10-20 consisted of a close investigation of the Cormorant borehole area and were plotted on a trace of a lattice chart at 1:10 000 scale provided by Shell.

All fair plots were approved by the senior scientist and passed to IGS Marine Geophysics Unit.

SATELLITE NAVIGATION SYSTEM

Hardware

The lower tape transport was returned from servicing by the manufacturer's UK branch and installed without problem. The only failure was on the upper tape transport which lost tape tension when taking over from the lower transport at the end of its tape. This

caused a data break of several hours. Two data tapes were recorded, both on the lower transport.

No other hardware failures occurred. Power supplies from the deck generator were maintained without failure.

Operation

Problems with satellite pass solutions as described in MGU Report No 60 (Project 75/07) continued on a reduced scale. Operation with manual speed input alongside the quay at Aberdeen produced very good updates and frequency offset solutions apart from a few specific instances which could mainly be attributed to the poor position of the antenna.

Operations on this project were in the centre of the area of coverage of Decca Main Chain OE. Here pattern geometry is good, lane expansion small and propagation characteristics generally excellent. Using a filter length of 100 seconds ($K1 = .01$) system response was generally good. However, the problems previously encountered in Project 75/07 recurred although in a less pronounced form. Satellite pass solutions often produced abnormally poor sigmas and frequency offset solutions. Automatic updates were only achieved in about half the expected cases. Satellite pass solutions causing automatic updates often agreed with Main Chain to within the normal accuracy limits but at times there were automatic updates causing alarming differences between the Decca and Sat/Nav positions. The system was allowed to run on "UPDATE AUTO" since on balance this seemed to produce more relevant updates than would have been achieved by manual updating on the basis of sigmas and frequency offset solution.

It was noticed that the doppler symmetry of many passes was very poor, valid counts being concentrated before zenith. No convincing explanation is apparent. However, the antenna position left much to be desired, being shadowed by the funnel and, to a lesser extent, by the lifeboat and radar gantry. Reradiation effects from these and other structures could possibly account for some of the oddities. In future, masthead antenna locations should be used if at all possible.

In summary it should be emphasised that whilst the use of Sat/Nav with Decca Main chain as the only source of dead-reckoning is usable where Decca propagation is good, it cannot be regarded as satisfactory while satellite pass solutions apparently continue to be corrupted by the nature of the dead-reckoning.

APPENDIX I

Ship Specification

Name: MV Aqua Star
Gross Tonnage: 750 tons
Length OA: 167 ft
Breadth: 33 ft
Draft: 12 ft 6 inches
Engines: British Polar: 1025 HP single screw
Speed: 13 knots maximum, 12 knots cruising
Owner: Aquatronics Ltd., Hunting House, Central Way,
Feltham, Middlesex.

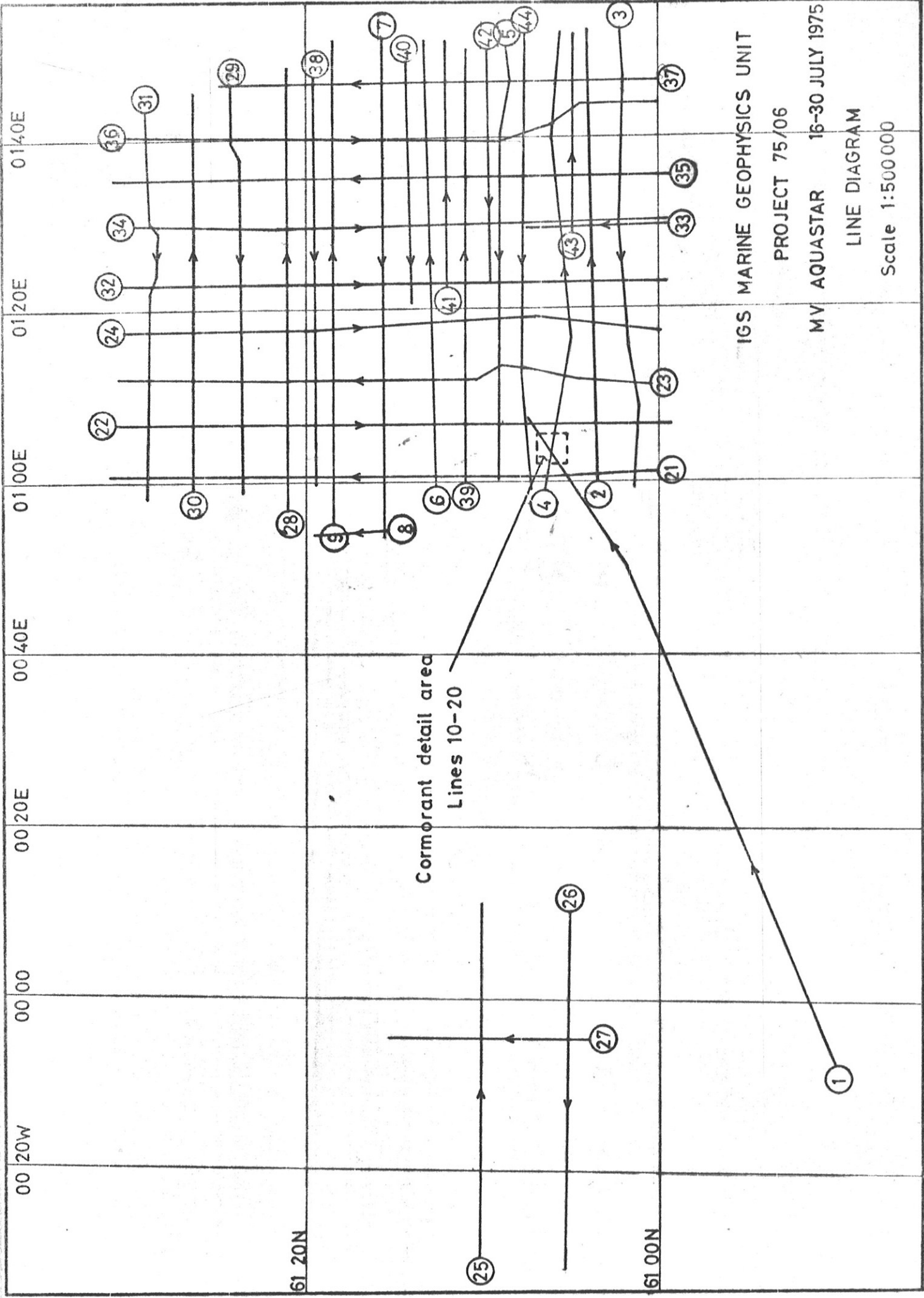
Personnel

M C Tully - Senior Scientist	}	Marine Geophysics Unit
N Kenolty		
A Rochester		
A Mould - Chief Surveyor		
D Evans	}	Continental Shelf Unit II
N Ruckley		
K Lake	}	Aquatronics Ltd
R Taylor		
D Bidgood	}	Nova Scotia Research Foundation
D Prentiss		
R Burton	}	Aquatronics/Wimpey (Surveyors)
M Reynolds		
M Milling (16-22 July) - Exxon		
K Taylor (16-22 July)	}	- Shell
P Sluiter (16-21 July)		
M Stanton (21-30 July) - Polytechnic Engineering		

APPENDIX II
TABLE OF INSTRUMENTS USED

LINE NO.	DATE	HI-FIX	SAT. NAV. M/C	DECCA M/C OE	ECHO SOUNDER	SEISMIC PROFILING SYSTEMS				FIX NO.	KM
						EDO PINGER	N/S DEEP TOW	MULTI SPARK	12 CHANNEL DIGITAL		
1	18.7.75		✓	✓	✓	✓	✓	✓		36	76.0
2	18.7.75		✓	✓	✓	✓	✓	✓		21	48.5
3	19.7.75		✓	✓	✓	✓	✓	✓		23	50.0
4	19.7.75		✓	✓	✓	✓	✓	✓		24	48.0
5	19.7.75		✓	✓	✓	✓	✓	✓		25	47.5
6	19.7.75		✓	✓	✓	✓	✓	✓		23	47.5
7	19.7.75		✓	✓	✓	✓	✓	✓		24	53.0
8	20.7.75		✓	✓	✓	✓	✓	✓		4	7.5
9	20.7.75		✓	✓	✓	✓	✓	✓		23	49.0
10	20.7.75	✓		✓	✓	✓	✓	✓		11	3.6
11	20.7.75	✓		✓	✓	✓	✓	✓		8	3.0
12	20.7.75			✓	✓	✓	✓	✓		8	2.9
13	20.7.75			✓	✓	✓	✓	✓		9	3.0
14	20.7.75	✓		✓	✓	✓	✓	✓		10	3.35
15	20.7.75			✓	✓	✓	✓	✓		12	3.2
16	20.7.75			✓	✓	✓	✓	✓		9	3.2
17	20.7.75			✓	✓	✓	✓	✓		9	3.0
18	20.7.75			✓	✓	✓	✓	✓		10	3.3
19	20.7.75			✓	✓	✓	✓	✓		10	3.15
20	20.7.75			✓	✓	✓	✓	✓		9	3.1
21	20.7.75		✓	✓	✓	✓	✓	✓		26	57.5
22	21.7.75		✓	✓	✓	✓	✓	✓		30	58.5
23	21.7.75		✓	✓	✓	✓	✓	✓		25	58.5
24	21.7.75		✓	✓	✓	✓	✓	✓		28	57.0
25	23.7.75		✓	✓	✓	✓	✓	✓	✓	125	37.5

LINE NO	DATE	HI-FIX	SAT.NAV M/C	DECCA M/C OE	ECHO SOUNDER	SEISMIC PROFILING SYSTEMS				FIX NO.	KM
						EDO PINGER	N/S DEEP TOW	MULTI SPARK	12 CHANNEL DIGITAL		
26	23.7.75		✓	✓	✓	✓	✓	✓		125	37.0
27	23.7.75		✓	✓	✓	✓	✓	✓	✓	70	20.5
28	24.7.75		✓	✓	✓	✓	✓	✓	✓	22	46.0
29	24.7.75		✓	✓	✓	✓	✓	✓	✓	26	42.5
30	24.7.75		✓	✓	✓	✓	✓	✓	✓	24	42.0
31	24.7.75		✓	✓	✓	✓	✓	✓	✓	26	40.5
32	25.7.75		✓	✓	✓	✓	✓	✓	✓	27	58.0
33	25.7.75		✓	✓	✓	✓	✓	✓	✓	10	15.0
34	26.7.75		✓	✓	✓	✓	✓	✓	✓	37	59.0
35	26.7.75		✓	✓	✓	✓	✓	✓	✓	36	59.0
36	26.7.75		✓	✓	✓	✓	✓	✓	✓	34	56.5
37	27.7.75		✓	✓	✓	✓	✓	✓	✓	25	46.0
38	27.7.75		✓	✓	✓	✓	✓	✓	✓	27	43.0
39	27.7.75		✓	✓	✓	✓	✓	✓	✓	150	45.0
40	27.7.75		✓	✓	✓	✓	✓	✓	✓	15	25.0
41	27.7.75		✓	✓	✓	✓	✓	✓	✓	12	25.5
42	28.7.75		✓	✓	✓	✓	✓	✓	✓	13	24.5
43	28.7.75		✓	✓	✓	✓	✓	✓	✓	10	21.0
44	28.7.75		✓	✓	✓	✓	✓	✓	✓	25	47.5



IGS MARINE GEOPHYSICS UNIT

PROJECT 75/06

MV AQUASTAR 16-30 JULY 1975

LINE DIAGRAM

Scale 1:500 000