FINAL FIELD OPERATION REPORT
MARINE SEISMIC REFLECTION SURVEY

Statoil
Volve
Block 15/9

WesternGeco Job No. 9238

Statoil Project No : ST0202

Acquire by

Geco Angler & Western Inlet

From June 13th to July 16th ,2002

Report Compiled by Peter Shutleworth / Bernd Schotte

The Survey Parameters and Job Configuration details listed in this report are for the purpose of reporting General information and should not be used for Data Processing Purpose.

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General Information

1. Survey Information and Objectives

1.1. General

Statoil have planned and awarded the acquisition of a 4-Component seabed 3D Survey around Volve, in the Central North Sea to WesternGeco. The survey consists of 76.2 sq. km of full-fold 3D located approximately 6 kilometres north of the Sleipner A installation. Water depths are around 85 meters throughout the survey area. The survey is planned to commence in early June and projected to take 30 days.

The survey scope is to deploy two receiver cables on the seabed and then to record data onto one vessel, which remains on station under dynamic positioning, whilst a second vessel makes a series of source passes adjacent to the cables. The 3D technique will employ two six km 4-component cables and dual 2250 in^3 sleeve gun source arrays. Post plot positioning of each seabed cable is done by acoustic transponders co-located on receiver stations along the cable.

The survey area is divided into six swaths. Each swath comprises two receiver lines and 24 source lines. Priority swaths are designated as swaths 1,4 and 6.

Two vessels, the Geco Angler and Western Inlet mobilised to conduct the survey. The Geco Angler acted as the recording vessel with the Western Inlet as source vessel.

The survey started on the 13th June with completion on the 15th July

1.2. Seismic Vessels

1.2.1. Recording vessel, Geco Angler

The Geco Angler is owned by Rem Offshore A/S in Norway, was built in Norway by Flekkefjord Slipp & Maskinfabrikk/REM Offshore and commissioned in July 1998. The vessel is chartered by WesternGeco as a multipurpose 4C/3D Cable Handling & Source Vessel and 4 streamer 3D Towed Seismic Vessel.

The vessel was built in Norway in 1998 according to classification 1A1,Ice C, EO, Dynpos AUT R, GR, Heldk and has sufficient berth space for a crew of 44.

The most recent external Safety Audit was conducted by Santos on 17th January 2002. An internal QHSE Management System Audit was carried out 12th-14th October 2001. Vessel ISM approval was achieved in Stavanger on 26th April 2002. Dynamic Positioning trials were conducted offshore Stavanger on 28th April 2002, ensuring the vessel is both OLF and UKOOA compliant to survey in both the Norwegian and UK sectors of the North Sea.

In addition to Inmarsat M, the Geco Angler employs a high-speed data link to shore via its Norsat C. It is equipped with a forward mounted helideck rated for Super Puma helicopters with a D-rating of 19.5 metres. The vessel is also equipped with two jet powered fast rescue craft (FRC).

1.2.2. Source vessel, Western Inlet

The Western Inlet, Call Sign HO 5450, is owned by Western Sea Services of Panama and classified as a Seismic Survey Vessel. Overall length is 60.4 metres and draft is 4.0 meters. The vessel was built in Singapore in 1980 according to classification ABS / A1 E; AMS. The vessel has berth space for a crew of 37. In addition to Inmarsat, Western Inlet employs a high-speed data link to shore via its VSAT. This system also acts as a high-speed relay for data from Geco Angler. A GSR safety audit of the vessel was conducted alongside in Drammen, Norway on 25th April 2002

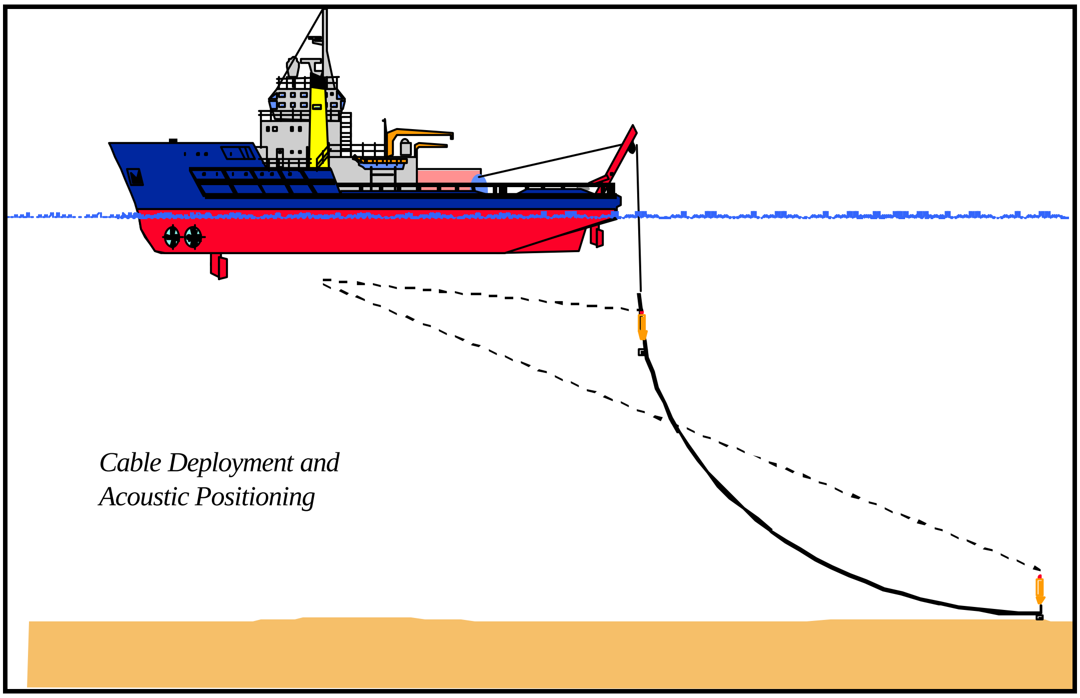
Field Technique

1.2.3. Pre-survey scouting and survey preparation

Prior to any seismic acquisition, a reconnaissance survey using side-scan sonar is performed to cover all planned seismic receiver line locations. The recording vessel, Geco Angler, and the source vessel, Western Inlet performs this survey jointly.

1.2.4. Deployment of seabed cables

The seismic cables are deployed over the stern of the Angler onto the seabed as she traverses along pre-plotted receiver lines. Positional data from USBL transponders is acquired continuously during the deployment of each cable. The cable is lowered onto the seabed whilst maintaining a low positive cable-tension, through the use of the vessel's DP.

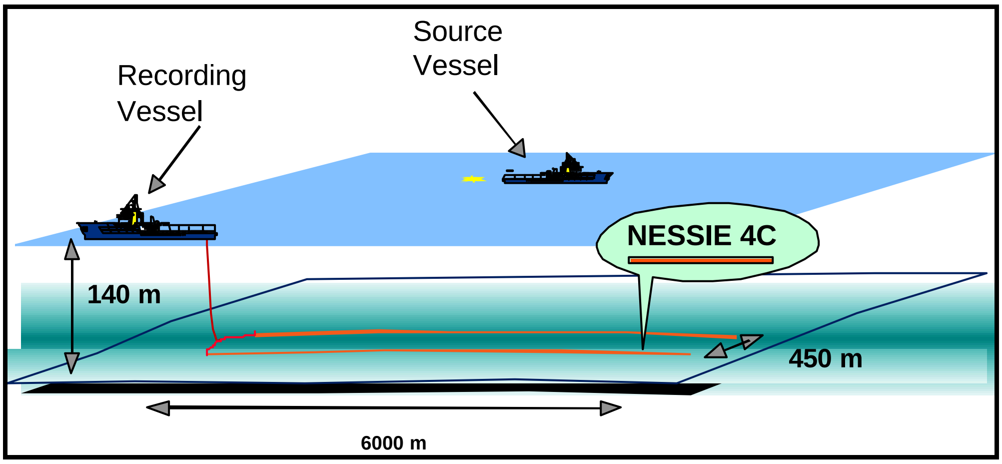


Once the first cable is in position, the forward end is buoyed off to allow the vessel to start deploying the second. After the second cable is fully deployed, the lead-in of the first cable is picked up again and connected to the Geco Angler for simultaneous recording of seismic data from both cables. The recording vessel then deploys additional lead-in to allow more freedom of movement, without dragging the front end of the cables.

1.2.5. Positioning of seabed cables

In addition to the USBL transponders (placed at both ends of the cable and at every 1,000 meters along its length), an extra positioning system is used. This system consists of acoustic transponders attached to the cable at intervals of 100m. The position of these is determined by ranging from a hull transceiver on the Western Inlet, as she runs parallel to the cables, during the normal seismic lines. Once all ranges are acquired, the final position of each stationary cable is determined.

1.2.6. Acquisition of 'source lines'



As soon as the cables and guns are deployed, the source vessel begins firing the airguns, and the data acquisition process commences.

1.2.7. Recovery and redeployment of cables

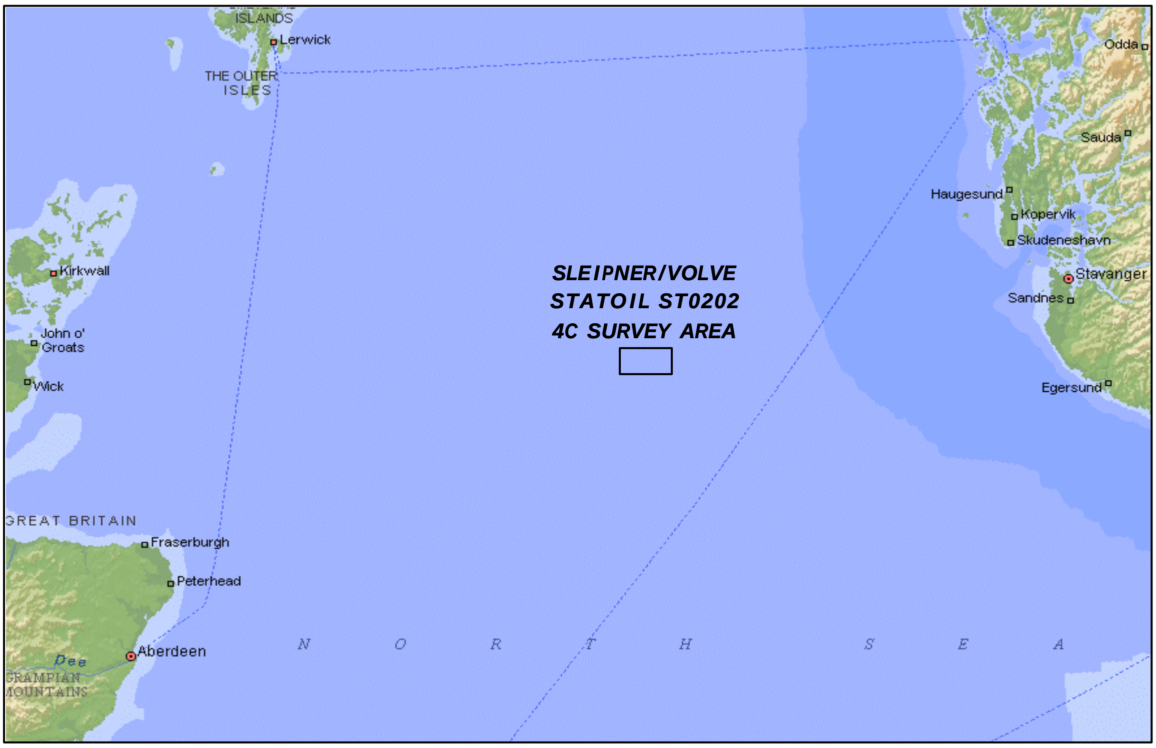
Once the swath of data associated with a specific pair of seabed cable locations is acquired the Geco Angler commences the recovery phase. One lead-in is buoyed off and the vessel, using DP, backs down on the remaining cable with a loop of cable within the water column. The position of the cable is monitored at all times using data from the USBL's located every 1000m along the cable.

The cable adjacent to the next swath is normally recovered first and re-deployed at the next cable location. The remaining cable is then recovered and re-deployed. This practice cannot always be followed due to occasions of bad weather and moving from one side of the prospect to the other due to field timings.

1.2.8. 'Positioning' runs

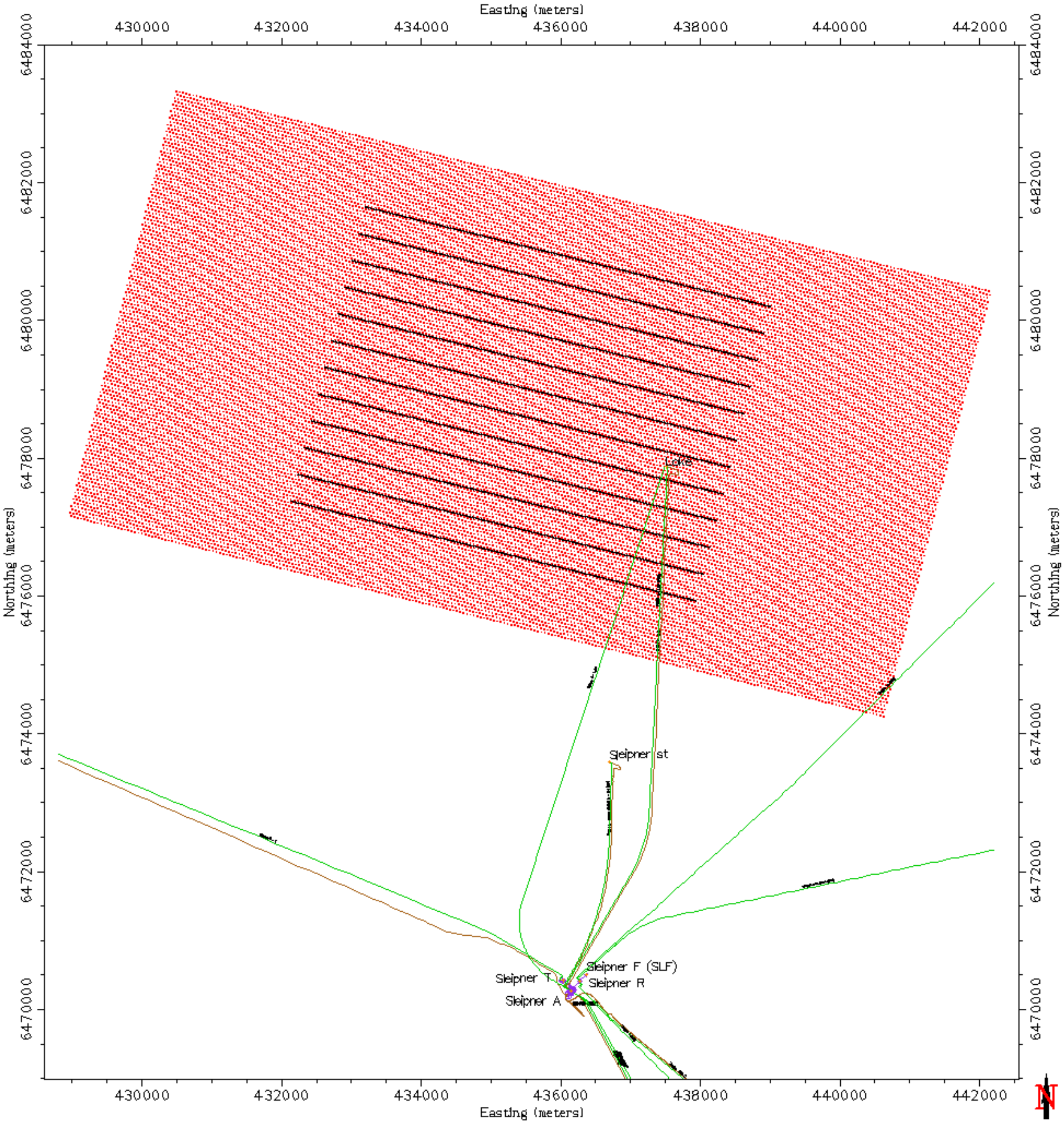
Once the first cable is deployed in its new position, the Western Inlet makes positioning runs to either side of the cable. A third position run is made immediately after the Geco Angler has laid the 2nd cable. The fourth and final position run is made simultaneously with the first production run.

2. Area Map



ISLANDS
Lerwick
THE OUTER ISLES
Odda
Sauda
Haugesund
Kopervik
Skudeneshavn
Stavanger
Sandnes
Egersund
Kirkwall
John o' Groats
Wick
SLEIPNER/VOLVE
STATOIL ST0202
4C SURVEY AREA
GREAT BRITAIN
Fraserburgh
Peterhead
Aberdeen
Dee
GRAMPIAN MOUNTAINS
N O R T H S E A

3. Program Map



4. Job Book

Acquisition Parameters

General

Client	Statoil
Vessel(s)	Geco Angler and Western Inlet
Job Number	9238
Client Contract Number	ST0202
Location	Volve, Block 15/9, Offshore Norway
Type of Survey (2D or 3D)	4C OBC 3D
Average Line Length	6 km RL, 12 km SL
Estimated Start Date	10 June 2002
Estimated Duration	30 days
Supervision required	No – not a client deliverable

OBC Acquisition Parameters

Survey Area	
Full fold area	
Source area	76.2 km²
Receiver area	26.4 km²
Receiver line orientation	284°
Acquisition Geometry	
Basic Geometry (in-line, orthogonal)	In-line
Patch / Swath design	
Active receiver line length (B)	6000 m
Receiver line spacing (C)	400 m
Number of receiver lines	2
Receiver station interval	25 m
Number of source sail-lines	24
Source line spacing	50 m sail-line spacing
Source line length (D)	12.0 km
Shotpoint interval	25 m
X-line offset limitation (A)	975 m
Fold	

Patch / Swath Roll	
Patch roll (in-line)	N/A
Patch roll (x-line)	800 m
Number of swathes	6
Bin Dimension	
Bin width	25 m
Bin length	12.5 m
Detector Array	
Group configuration	7 Sensors/group over 9 meters (1.5m spacing
Detector constituents	4C (PXYZ)
Hydrophone Specification	
Natural frequency	10 Hz
Sensitivity	8.4 V/Bar
Geophone Specification	
Natural frequency	10 Hz
Sensitivity	20.95 V/m/s

Recording

Recording system	Triacq
Recording format	SEG D 8015 rev 2
Record length	10 seconds
Sample rate	2 ms
Recording filter (Hi-Cut)	200 hz / 406 dB/octave
Recording filter (Low-Cut)	3 hz / 18 dB/octave
Recording filter delay	48.07 ms
Filter type	Linear
Recording system delay	N/A (Zero)
Pre-amplifier Gains (PXYZ)	Hyd. = 215.5, Geoph. = 10.8
Recording media	3590
Dual recording / Tape copies	Yes
Auxiliary channels	
TOC (Diskos/Petrobank) files required?	Yes

Source Parameters

Source	
Source type	Sleeve gun array (SG II)
Number of sources	2
Source separation	50 m
Shotpoint interval per shot	25.0 m (50.0 m per CDP line)
Array volume / source	2250 in³
Operating pressure	2000 psi
Source depth	6 m
Number of subarrays per source	3
Subarray separation	6 m
Number of Airguns per Subarray	8
Sub array length	15.0 m
Gun Timing Specification	± 1.0 ms
Alternatively fired sources (flip-flop)	Yes
Source control system	SSS
Firing delay	0.640 ms
Record nearfields	Yes (MSX recorder Western Inlet)
Total SCFM required at 4.8 knots	NA
Source timing specifications	1.0 ms
Calibrated Marine Source (CMS) required	No
CMS positions	No

Additional Notes

The source vessel gun firing synchroniser SSS data string output is converted to TRISOR format prior to transfer across 2-boat link.

The SSS information is also recorded locally on the source vessel to MSX recorder with near field signatures.

The reformatting and transfer of the data allows for recording external header information to be written to SEG-D tape and suitable QC of the source information remotely.

5. Vessel Description

SHIPS NAME	**M/V Geco Angler**
CALL SIGN	LAIX5
INTERNATIONAL MARITIME ORG. (IMO) No.	9181467
OWNER	Rem Offshore A/S Fosnavåg Norway
PREVIOUS NAME	
FLAG STATE & PORT OF REGISTRY	Åleasund, NIS
PANAMA OFFICIAL No.	
DATE OF BUILD	20-Jun-98
YARD No. AND TYPE OF VESSEL	153, Research
YARD BUILT	Flekkefjord Slipp &Maskinfabrikk
DATE CONVERTED / POWER UPGRADED	
YARD CONVERTED	
CLASSIFICATION SOCIETY AND CLASS	1A1 ICE-C HELDK E0 DYNPOS-AUTR
CLASS ID No.	DNV 19261
CLASSIFICATION MACHINERY SYSTEM	
CLASS APPROVED MAINTENANCE SYSTEM	
INTERNATIONAL SAFETY MANAGEMENT, (ISM) CODE COMPLIANCE	
SAFE MANNING CERTIFICATE (MINIMUM)	

PRINCIPAL PARTICULARS

GROSS TONNAGE (GRT)	3080 M/T
(GRT) NATIONAL & INTERNATIONAL	3080 M/T
GROSS TONNAGE (GRT) SUEZ CANAL	
NET. REG.TON (NRT) PANAMA CANAL	
(NRT) NATIONAL & INTERNATIONAL	924 M/T
NET. REG. TON (NRT) SUEZ CANAL	
LIGHTSHIP DISPLACEMENT	2349,68
DEAD WEIGHT	
LENGTH OVER ALL (LOA)	66.00
LENGTH BETWEEN PERPENDICULARS	58.80
BREADTH (MOULDED)	14.00
BREADTH (EXTREME)	16.50
DEPTH (MOULDED)	8.55
DRAFT (MAX)	6.50
DRAFT (MEAN)	6.50
AIR DRAFT (TO HIGEST ANTENNA)	28.00
HELICOPTER DECK RATING	Super Puma AS332 L2
HELICOPTER DECK DIAMETER (D-VALUE)	D – value 19,5 metres
HELICOPTER DECK MARKINGS STANDARD	ICAO Annex 14 vol ??, NMD, Helikopter Service, UK CAA – cap 437 and

CAPACITIES AND ENDURANCE'S	Quantity / Make / Model / Year Renewed.
CABLE / TOWPOINTS / SUBARRAYS	
PULLING CAPACITY, 5 KNOTS	
FRESH WATER CAPACITY	71,00 m3
FRESH WATER MAKER PRODUCTION	Evaporator, 13,00 m3
Engineroom HP Air compressors	
POTABLE WATER SYSTEM	
FUEL CAPACITY, ALL TANKS TOPPED	800 cum
FUEL, USEFUL FOR 100 % CONSUMPTION	650 cum
FUEL TYPE	Gasoil
FUEL TANK HEATING	NO
LUB. OIL, ENGINE OIL (m^3)	50 cum
CYLINDER OIL, HP COMPRESSORS (m^3)	
CABLE OIL, KEROSENE (Clean/separated/dirty)	40 cum
BALLAST, SEA WATER (m^3)	NO
SPEED, TRANSIT, MAX. IN CALM SEA	13.5 kn
SPEED, TRANSIT ECONOMY, DITTO	12 kn
CONSUMPTION OF FUEL , FULL SPEED	17 cum
CONSUMPTION OF FUEL, ECONOMY SPEED	14 cum
OPERATIONAL ENDURANCE	
ENDURANCE OF FUEL DURING SURVEY	10cum
CONSUMPTION OF FUEL IN PORT	2 cum
SAFETY EQUIPMENT CERTIFICATE	

BRIDGE NAVIGATION EQUIPMENT

RADAR No 1	1 X – band, Furuno / FR 2110
RADAR No 2	1 S – band, Furuno / FAR 2835
RADAR No 3	N/A
ECDIS	
GYRO COMPASS	2 Simrad Robertson RGC 11
AUTO PILOT	1 Robertson / AP9
GPS RECEIVER	1 Furuno GP 80
SPEED LOG	1 Furuno / DS – 70
ECHO SOUNDER	1 Furuno / FE – 680, 1 Simrad EA 500
RADIO'S, VHF, GMDSS*, Type 1	1 Sailor RT 2048, DSC RM2042, 3 GMDSS Sailor SP 3110
RADIO'S, VHF, GMDSS*, Type 2	1 Sailor RT 2048, DSC RM2042, 3 Sailor SP 3110
RADIO'S, VHF, GMDSS*, Type 3	
RADIO'S, UHF	
RADIO DIRECTION FINDER	Taiyo TD – L1550A
WEATHER FACSIMILE	1 Furuno FAX – 208 MARK 2

BRIDGE NAVIGATION EQUIPMENT - Cont

NAVTEX RECEIVER	Furuno NX 500
UPS, POWER SUPPLY TO ALL GMDSS RADIO'S	

COMPLIANT WITH GMDSS REQUIREMENTS	Quantity / Make / Model / Year Renewed
RADIO STATION LICENCE No.	63883
CLASS / CORR. CATEGORY	
SHIP / AIR CRAFT RADIO	Jotron Transceiver TR – 6101
HELICOPTER BEACON	Remote control NDB Jotron
TRANSMITTER / RECEIVER, MAIN (MF)	1 Sailor MF/HF RM 2150
TRANSMITTER / RECEIVER, RESERVE (MF)	Sailor compact H 2095 B
TRANSMITTER / RECEIVER, MAIN (VHF)	
TRANSMITTER / RECEIVER, MAIN (DSC)	
WATCH KEEPING RECEIVER	
RADIO, PORTABLE, UHF	
BOOSTER UNIT FOR PORTABLE RADIO (UHF)	
EMERGENCY RADIO BEACON (EPIRB)	Jotron Tron 40 S
RADAR TRANSPONDER	Jotron Tron Sart
RADIO, LIFEBOAT, VHF	

SATELLITE COMMUNICATIONS

INMARSAT TYPE A/B	
INMARSAT TYPE C	Sailor H 2098 B
INMARSAT TELEX No./ TELEPH.No./ FAX.No.	
NORSAT-C. ONLINE TELE LINK TO OSLO 24hr	+ 47 66 78 84 45 (6)
TELEFAX MACHINE	
INTERNAL E-MAIL & PC-NETWORK	
E-MAIL ADDRESS TO VESSEL	

SAFETY EQUIPMENT CREW

LIFEBOAT TYPE / CAPACITY/ No. OF BOATS	Viking 25 DKF+
ENGINE, LIFEBOAT	
LIFERAFTS TYPE /CAPACITY	
NUMBER OF LIFE RAFTS	6+1
LIFEJACKETS no.	Seamaster 1983 Lifejacket
SURVIVAL SUITS, THERMO INSULATED	Imperial ISS 590 I
WORKING SUITS, THERMO INSULATED	Helly Hansen E – 300 – 2
MAN OVERBOARD BOAT (MOB) TYPE	Norsafe magnum 7,5 m
ENGINE, MOB AND SPEED OF BOAT	Yanmar 4 LH- STE
WATERJET AND GEAR DRIVE, MOB	Hamilton 212 waterjet
WORK BOAT	Norsafe Magnum 7,5m
ENGINE WORK BOAT AND SPEED OF BOAT	Volvo – 25knots

FIXED FIRE EXTINGUISHER SYSTEM	Quantity / Make / Model / Year Renewed.
ENGINE ROOM	AFFF Uniral, Foam 3%
SEPARATOR ROOM	
INCINERATOR ROOM / GALLEY DUCTING	CO2
TAPE STORE	
CABLE STORE	AFFF Uniral, Foam 3%
STEAMER WINCH ROOM	AFFF Uniral, Foam 3%
HELICOPTER DECK	AFFF Uniral, Foam 3%
PAINT STORE	CO2
CHEMICAL STORE	
MAIN FOAM PUMP, AFFF FOAM MIXTURE	NB 50-200 / 65-260, 110m3/h / 90m3/h
MAIN FIRE PUMP	Engine room / 2 pcs.
EMERGENCY FIRE PUMP	NB 32-160/17, 25 m3/h
FIRE DETECTION MONITORING SYSTEM	

HULL OUTFITTING

ANCHOR	2 Spek 2625kg
WINDLASS	2 Karmøy Winch, Karm 162738
MOORING WINCHES	
CAPSTAN No 1	1 Karmøy Winch, M361058
CAPSTAN No 2	
DECKS CRANE 1, Capacity/Reach/Location	1 Hydralift Crane, 10 T
DECKS CRANE 2, Capacity/Reach/Location	1 Maritime GMC, 4 T
DECKS CRANE 3, Capacity/Reach/Location	
DECKS CRANE 4, Capacity/Reach/Location	
ANTI ROLLING DAMPING SYSTEM	1 Passive Stabilizer tank
HEELING TANKS, VOLUME AND FUEL/FW/SW	NO
BUNKER CONNECTIONS, locations	
BUNKER CONNECTIONS, Type(s)	
BUNKER HOSE length and dimension (loose)	
CREW ACCOMMODATION, No OF BUNKS	
SINGLE BERTHS CABINS	9
DOUBLE BERTHS CABINS	17
CLIENT CABINS, SINGLE BERTHS	
BUISNESS CONFERENCE AND TRAINING RM	
SAUNA AND FITNESS ROOM	

INTERNATIONAL OIL POLLUTION PREVENTION (IOPP) EQUIPMENT

INCINERATOR, SLUDGE AND WASTE OIL	Powec A.S PMP 6.24 SIC
BILGE / OILY WATER SEPARATOR	World Water System, Heli – Sep. Mod - 1000
OILY WATER / SLUDGE HOLDING TANKS CAP.	
OIL SPILL ABSORBENT / DAMAGE CONTROL	

MACHINERY EQUIPMENT	Quantity / Make / Model / Capacity/Year Renewed.
AIR SOURCE, HP COMPRESSORS	LMF, 3 each
AIR CAPACITY, EACH AND TOTAL (CFM)	1660, 1660, 1660
HP COMPRESSOR DRIVE MOTORS	
MAIN ENGINE OR ELECTRIC PROP. MOTORS	1Caterpillar inc. – Lafayette, INDIANA, 3612 DITA, 5096 bhp. 3800 Kw
AUXILIARY ENGINES (GENERATOR DRIVE)	2 Caterpillar inc. – Lafayette, INDIANA, 3512B DITA, 1910 bhp. 1424 Kw
REDUNDANCY PROPULSION, AZ-THRUSTER	1Kamewa Finland oy, Aquamaster Thruster UL 2001/6100, 1500Kw
VESSELS TOTAL BRAKE HP / KW FOR PROP.	
MAIN ENGINES, POWER SUPPLY	
PROPELLER TYPE, MAIN PROPULSION	4 blades
PROPELLER and THRUSTER CONTROL	
PROPELLER BLADE, SPARE	NO
GENERATORS / ALTERNATORS	2 Caterpillar, SRB4 – 824, 1360 Kw
EL. POWER, USEFUL, OUT FROM M.S.BOARD	
UPS POWER TO INSTRUMENT ROOM	Merlin Gerin, Galaxy DW 40kva
POWER SUPPLY INSTR.ROOM BACK-UP	
EMERGENCY & HARBOUR GEN. ENGINE	1Cummins Eng. Company Ltd. 6 CTA 8,3G
EMERGENCY & HARBOUR GENERATOR	
FUEL BACK-UP SYSTEM FOR AUX. ENG.	
COOLING SYSTEM FOR AUX. ENGINES	
BOW THRUSTER	1 Brunvoll A/S, Molde / FU 80 LTC 2000, 1 Brunvoll A/S, Molde / FU 80 LTC 2000
FRESH WATER GENERATOR (FWG)	Aquamar, AQ – 12/16, 13 m3 / 24h
BOILER, EXHAUST GAS & OIL FIRED	
STEERING GEAR	2 Ulstein Tenfjord, SR 642

SHIPS NAME	**R/V Western Inlet**
CALL SIGN	HO 5450
INTERNATIONAL MARITIME ORG. (IMO) No.	8112744
OWNER	Western Sea Services of Panama
PREVIOUS NAME	None
FLAG STATE & PORT OF REGISTRY	Panama, Panama
PANAMA OFFICIAL No.	11437-81-E
DATE OF BUILD	03-Nov-80
YARD No. AND TYPE OF VESSEL	SKS 566; Seismic Research Vessel
YARD BUILT	Sing Koon Seng (PTE) Limited
DATE CONVERTED / POWER UPGRADED	N/A
YARD CONVERTED	N/A
CLASSIFICATION SOCIETY AND CLASS	ABS; *A1 E *AMS
CLASS ID No.	8124349
CLASSIFICATION MACHINERY SYSTEM	Planned Maintenance System (TM MASTER)
CLASS APPROVED MAINTENANCE SYSTEM	TM MASTER
INTERNATIONAL SAFETY MANAGEMENT, (ISM) CODE COMPLIANCE	
SAFE MANNING CERTIFICATE (MINIMUM)	No. M3239 (9 total)

PRINCIPAL PARTICULARS

GROSS TONNAGE (GRT)	1241
(GRT) NATIONAL & INTERNATIONAL	1241
GROSS TONNAGE (GRT) SUEZ CANAL	
NET. REG.TON (NRT) PANAMA CANAL	gross: 2007; net 1410
(NRT) NATIONAL & INTERNATIONAL	372
NET. REG. TON (NRT) SUEZ CANAL	
LIGHTSHIP DISPLACEMENT	1382.38
DEAD WEIGHT	
LENGTH OVER ALL (LOA)	60.4 mtr
LENGTH BETWEEN PERPENDICULARS	58.628 mtr
BREADTH (MOULDED)	12.0 mtr
BREADTH (EXTREME)	
DEPTH (MOULDED)	4.88 mtr
DRAFT (MAX)	
DRAFT (MEAN)	4.0 mtr
AIR DRAFT (TO HIGEST ANTENNA)	21.8 mtr
HELICOPTER DECK RATING	none
HELICOPTER DECK DIAMETER (D-VALUE)	
HELICOPTER DECK MARKINGS STANDARD	

CAPACITIES AND ENDURANCE'S	Quantity / Make / Model / Year Renewed.
CABLE / TOWPOINTS / SUBARRAYS	2 X Century Solid Streamer 1x8 / 4 tow points / 6 sub arrays
PULLING CAPACITY, 5 KNOTS	2722 kg
FRESH WATER CAPACITY	96.7 m3
FRESH WATER MAKER PRODUCTION	11 m3/day
Engineroom HP Air compressors	
POTABLE WATER SYSTEM	Reverse Osmosis
FUEL CAPACITY, ALL TANKS TOPPED	500.4 m3
FUEL, USEFUL FOR 100 % CONSUMPTION	500.4 m3
FUEL TYPE	Marine Gas oil (Diesel Oil # 2)
FUEL TANK HEATING	none
LUB. OIL, ENGINE OIL (m^3)	10 m3 Mobilgard 450
CYLINDER OIL, HP COMPRESSORS (m^3)	2.6 m3 Rarus 827
CABLE OIL, KEROSENE (Clean/separated/dirty)	22.5 m3 clean / 12 m3 dirty
BALLAST, SEA WATER (m^3)	250 m3
SPEED, TRANSIT, MAX. IN CALM SEA	10.5
SPEED, TRANSIT ECONOMY, DITTO	10
CONSUMPTION OF FUEL , FULL SPEED	9-10 m3
CONSUMPTION OF FUEL, ECONOMY SPEED	8 m3
OPERATIONAL ENDURANCE	55 days
ENDURANCE OF FUEL DURING SURVEY	38 days
CONSUMPTION OF FUEL IN PORT	1 m3
SAFETY EQUIPMENT CERTIFICATE	IMO No. 8112744

BRIDGE NAVIGATION EQUIPMENT

RADAR No 1	Furuno FR-2110 ARPA
RADAR No 2	Furuno FAR-2825 ARPA
RADAR No 3	
GYRO COMPASS	Sperry, MK 227
AUTO PILOT	Robertson Autopilot, AP9 MKII
GPS RECEIVER	Trimble NT200 DGPS
SPEED LOG	
ECHO SOUNDER	Furuno Color Video Sounder, FCV-667
RADIO'S, VHF, GMDSS*, Type 1	2XSkanti TU 3000 & Sea 7157
RADIO'S, VHF, GMDSS*, Type 2	Hand-Held - 3XSailor SP3110 & 2XNavico AXIS 250
RADIO'S, VHF, GMDSS*, Type 3	Sea 7157
RADIO'S, UHF	Skanti TU9251 S D6T PCH
RADIO DIRECTION FINDER	
WEATHER FACSIMILE	Furuno Dfax
NAVTEX RECEIVER	ALDEN AE-900
UPS, POWER SUPPLY TO ALL GMDSS RADIO'S	4X 45 MBP Suprema Dupla Carga 12v 150a

COMMUNICATION EQUIPMENT

COMPLIANT WITH GMDSS REQUIREMENTS	Quantity / Make / Model / Year Renewed
RADIO STATION LICENCE No.	10966-H // 08 Nov 2003
CLASS / CORR. CATEGORY	A1, A2, A3 (GMDSS)
SHIP / AIR CRAFT RADIO	ICOM PS-80
HELICOPTER BEACON	Southern Avionics, SA100
TRANSMITTER / RECEIVER, MAIN (MF)	Skanti TU9251 S D6T PCH
TRANSMITTER / RECEIVER, RESERVE (MF)	
TRANSMITTER / RECEIVER, MAIN (VHF)	Skanti TU 3000
TRANSMITTER / RECEIVER, MAIN (DSC)	Skanti TU9251 S D6T PCH
WATCH KEEPING RECEIVER	
RADIO, PORTABLE, UHF	
BOOSTER UNIT FOR PORTABLE RADIO (UHF)	
EMERGENCY RADIO BEACON (EPIRB)	Tron 30S Mk II
RADAR TRANSPONDER	Tron Sart
RADIO, LIFEBOAT, VHF	Standard Marine VHF

SATELLITE COMMUNICATIONS

INMARSAT TYPE B	SEA-TEL, model TAC-92
INMARSAT TYPE C	Skanti Scan Sat CT
INMARSAT TELEX No./ TELEPH.No./ FAX.No.	Vsat 713-689-1953 or 1954 and Bsat 011 874 335 414 810
NORSAT-C. ONLINE TELE LINK TO OSLO 24hr	
TELEFAX MACHINE	RICHO FAX 550
INTERNAL E-MAIL & PC-NETWORK	
E-MAIL ADDRESS TO VESSEL	Crew58Captain@westerngeco.com

SAFETY EQUIPMENT CREW

LIFEBOAT TYPE / CAPACITY/ No. OF BOATS	
ENGINE, LIFEBOAT	
LIFERAFTS TYPE /CAPACITY	Viking, 20 man
NUMBER OF LIFE RAFTS	4
LIFEJACKETS no.	41 Muster Deck Lockers / 37 Cabins
SURVIVAL SUITS, THERMO INSULATED	37 Immersions Suits
WORKING SUITS, THERMO INSULATED	15 Mustang Survival Work Suits
MAN OVERBOARD BOAT (MOB) TYPE	Sea Bear 23 - *Temp Replacement = Alusafe 700 FRB, Volvo Penta waterjet, speed 25 knots.*
ENGINE, MOB AND SPEED OF BOAT	Volvo Penta, speed about 25 knots
WATERJET AND GEAR DRIVE, MOB	
WORK BOAT	Avon AR5.4; s/n GB-AVB13574F798
ENGINE WORK BOAT AND SPEED OF BOAT	2 x Yanmar 36 hp - 15 knots

FIXED FIRE EXTINGUISHER SYSTEM	Quantity / Make / Model / Year Renewed.
ENGINE ROOM	Halon
SEPARATOR ROOM	
INCINERATOR ROOM / GALLEY DUCTING	CO2 incinerator // waterfoam galley
TAPE STORE	Halon
CABLE STORE	
STEAMER WINCH ROOM	
HELICOPTER DECK	water or 3% AFFF
PAINT STORE	CO2
CHEMICAL STORE	CO2
MAIN FOAM PUMP, AFFF FOAM MIXTURE	Goulds pump, 36 m3/hour
MAIN FIRE PUMP	Goulds pump, 80 m3/hour
EMERGENCY FIRE PUMP	Lister Diesel, Desmi pump 25 m3/hour
FIRE DETECTION MONITORING SYSTEM	5 heat sensors engines to Bridge

HULL OUTFITTING	
ANCHOR	Nippon Chain & Anchor
WINDLASS	KOYO KS W5A 305010
MOORING WINCHES	
CAPSTAN No 1	
CAPSTAN No 2	
DECKS CRANE 1, Capacity/Reach/Location	1500 lb / 11.3 mt / Helo Deck, stbd side
DECKS CRANE 2, Capacity/Reach/Location	
DECKS CRANE 3, Capacity/Reach/Location	
DECKS CRANE 4, Capacity/Reach/Location	
ANTI ROLLING DAMPING SYSTEM	Flume Stabilization System
HEELING TANKS, VOLUME AND FUEL/FW/SW	
BUNKER CONNECTIONS, locations	port/stbd Forecastle Deck, aft
BUNKER CONNECTIONS, Type(s)	Camlock 4" Female
BUNKER HOSE length and dimension (loose)	30 mtr, 4"
CREW ACCOMMODATION, No OF BUNKS	37 bunks
SINGLE BERTHS CABINS	3
DOUBLE BERTHS CABINS	15 double // 1 four man
CLIENT CABINS, SINGLE BERTHS	
BUISNESS CONFERENCE AND TRAINING RM	
SAUNA AND FITNESS ROOM	Part of Tape Store

INTERNATIONAL OIL POLLUTION PREVENTION (IOPP) EQUIPMENT

INCINERATOR, SLUDGE AND WASTE OIL	Teamtec 065200, 55 ltr sludge/hour - 60 kg waste
BILGE / OILY WATER SEPARATOR	Helisep 500 OCD 2 m 22 gpm
OILY WATER / SLUDGE HOLDING TANKS CAP.	8.5 m3
OIL SPILL ABSORBENT / DAMAGE CONTROL	9 assorted drums & 120 ltr dispersant

MACHINERY EQUIPMENT	Quantity / Make / Model / Capacity/Year Renewed.
AIR SOURCE, HP COMPRESSORS	2 X Joy WBF 74XHD
AIR CAPACITY, EACH AND TOTAL (CFM)	
HP COMPRESSOR DRIVE MOTORS	2 X Caterpillar D-399 TA
MAIN ENGINE OR ELECTRIC PROP. MOTORS	2 X Caterpillar D-399 TA
AUXILIARY ENGINES (GENERATOR DRIVE)	2 X Detroit 12v71
REDUNDANCY PROPULSION, AZ-THRUSTER	
VESSELS TOTAL BRAKE HP / KW FOR PROP.	2 X 1090 HP at 1225 RPM c/w 3.6:1 reduction
MAIN ENGINES, POWER SUPPLY	
PROPELLER TYPE, MAIN PROPULSION	2 X KaMeWa 3500 KP variable pitch
PROPELLER and THRUSTER CONTROL	
PROPELLER BLADE, SPARE	
GENERATORS / ALTERNATORS	2 X Magna Max 350 kw 480v
EL. POWER, USEFUL, OUT FROM M.S.BOARD	650 kw
UPS POWER TO INSTRUMENT ROOM	40 kw
POWER SUPPLY INSTR.ROOM BACK -UP	
EMERGENCY & HARBOUR GEN. ENGINE	
EMERGENCY & HARBOUR GENERATOR	
FUEL BACK-UP SYSTEM FOR AUX. ENG.	P & Stbd day tank
COOLING SYSTEM FOR AUX. ENGINES	Keel cooling
BOW THRUSTER	Ulstein, type 90 VT 340 hp
STERN THRUSTER	
FRESH WATER GENERATOR (FWG)	Village Marine 11 m3/day
BOILER, EXHAUST GAS & OIL FIRED	
STEERING GEAR	Sperry Marine System

Operations Summary

6. List of Key Personnel

6.1. Onboard Personnel

Geco Bluefin	CREW 1	CREW 2
Party Manager	John Pope Peter Shuttleworth	
Captain	Lidvar Flusund	
Chief Engineer	Olav Solberg	
Acq. Supervisor	Morten Neilsen	
Acq. Shiftleader	Volker Petersen	
Pos. Supervisor	Peter Durran	
Pos. Shiftleader	Gary Whittle	
Handling Supervisor	Sisano Carenzo	
Shiftleader Mechanic	Stig Valdal	
Trilogy QC Leader	Emanuale Riva	
OBP Group Leader	Tracy Dorrington	

Western Atlas	CREW 1	CREW 2
Party Manager	Eric Gundersen	Roland Rattray
Captain	Harley Millar	Peter Deinhardt
Chief Engineer	Jens Bisgaard	Alf Eriksen
Acq. Shiftleader	Rubim Da Silva	David Purcell
Acq. Shiftleader	Richard Francisco	RB Garza
Pos. Supervisor	Paul Fitzgerald	Michael Morley
Pos. Shiftleader	James Wheatley	Carlos Martello
Handling Supervisor	Peter Phillips	Peter Phillips
Shiftleader Mechanic	John Brantley	Brady Degenstein

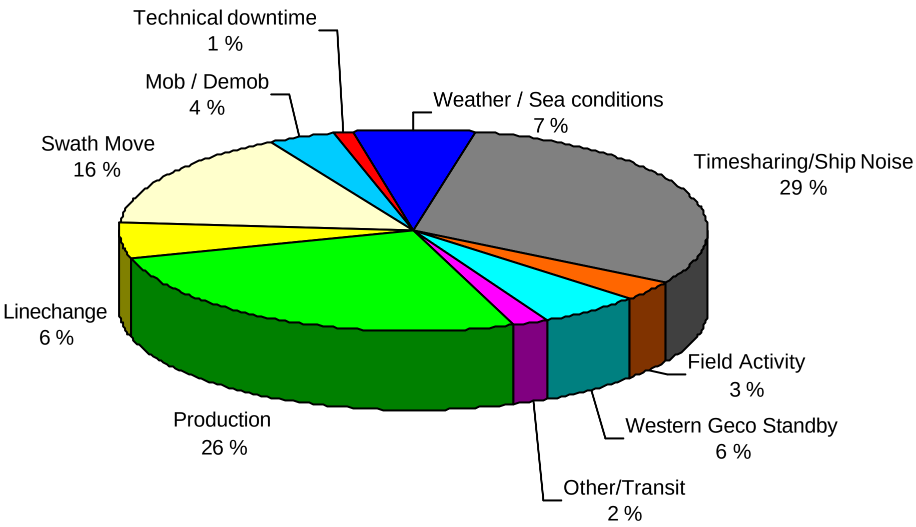
6.2. Office Support Personnel

POSITION	NAME	OFFICE
Operation Manager	Mark Osborn	Gatwick
Operation Supervisor	Stewart McFarlane / David Munro	Gatwick
Maritime Superint.	Erik Hanson	Gatwick
Instrument Support	Tim Bunting	Oslo
Navigation Support	Piere Morley	Gatwick
Mechanical Support	Steve Whitting	Oslo
Trilogy QC Support	Ian Alderson	Gatwick
OBP Supervisor	Ian Alderson	Gatwick

7. Field Information and Observations

7.1. Production Statistics

TIME DISTRIBUTION (Hours)		
Production	210,27 Hours	(26,2 %)
Linechange	44,62 Hours	(5,6 %)
Swath Move	124,84 Hours	(15,6 %)
Mob / Demob	30,00 Hours	(3,7 %)
Technical downtime	8,67 Hours	(1,1 %)
Weather / Sea conditions	52,77 Hours	(6,6 %)
Timesharing/Ship Noise	242,44 Hours	(30,2 %)
Field Activity	27,50 Hours	(3,4 %)
Western Geco Standby	45,43 Hours	(5,7 %)
Other/Transit	15,00 Hours	(1,9 %)
Total Survey time	801,54 Hours	(100 %)



7.2. Acquisition Effort

From the Revenue Figures we can summarise the effort entailed in completing the Volve 3D survey

RECEIVERS

Number of Swaths	6
Number of Receiver Lines / Swath	2
Length of Receiver Lines	6 km
TOTAL Survey Receiver Line Length	72 km

SOURCES

Number of Swaths	6
Number of Source Lines / Swath	24
Length of Source Line	12 km
TOTAL Survey Source Line Length	1728 km

This theoretical value is not actually correct as in flip-flop, dual source mode the sail line length is designed at 12050m. This provides a TOTAL Survey Source Line Length of 1735.2 km. 6

7.3. Daily Summary

Thursday 13th.June.

The Angler arrived at Volve block early afternoon after a short 13hr transit from Gullfaks field. The Inlet had arrived earlier in the day and had made good progress on side scanning the priority receiver lines.
After assessing the side scan data for the first swath to be laid the Angler got into position to start deploying the Port cable on Swath number 1.
The water depth on this prospect is shallower at 85m than the previous block we worked in and it soon became apparent that the currents in the area were quite strong and irregular in pattern. The first attempt at deploying the cable was delayed due to tracing down earth leakage in the streamer, changing out 2 sections, and then having to bring it in again due to an erratic current shift.
The second attempt was not much better with the USBL,s giving very erratic position data and with the malfunction of 1 USBL at a critical distance point. This resulted in the cable being out of position by 22m cross line. A timely arrival of an intouch reply from Tao in Nav support gave us some new information on settings to use for the USBL estimators. These smoothed the position data down considerably and by this time we also had a better feel for the current effects. The cable lay then continued without further incident and was nearing buoy off position at the end of the day.

Friday 14th June

Swath move was completed early afternoon and after a period of instrument tests, the vessels commenced production on the first of the priority swaths for the block, swath #1.
The Veritas Vantage who is shooting to the SW of us had contacted us earlier in the day and informed us of their shooting plans. We commenced our first line as he was also in production and whilst it initially appeared that the noise was unacceptable it later proved to be acceptable on the DMO stack.
On the next line this was not the case as the Vantages noise levels were a lot higher. He too was seeing us quite strongly so it was felt that we should agree on a mutual time-share agreement. This commenced in the late evening after which we received a call from Atlantic Explorer who are also in the area and are shooting to the North of us.
So it now appears we may have a three-way time-share, which is definitely not what we planned for. We thought we had seen the last of the Explorer when we were at Gullfaks however it is believed she is doing a small survey for Exxon before heading back to South Cormorant field to continue her Shell job.
At the end of the day the operation was standing by in time share with Vantage whilst they shoot a 5 and a half hour line.
ERT numbers were tested today to MRCC in SOLA, Gatwick emergency response group, Haukeland hospital, and the Statoil Emergency Team .

Total Production 48.2250 source line kilometers.

Saturday 15th June.

The weather picked up this morning, which shut down the two opposition vessels, whilst we continued in production. The Veritas Vantage spent all of the day doing streamer work whilst the Explorer went back into production later in the evening.
As we were only seeing very light Seismic interference from the Explorer we were reluctant to time share with them and continued shooting. Their onboard client however took the matter higher and we were later instructed by Statoil management ashore to time share with them.
Apart from the periods of time sharing the operation maintained a good level of production through out the day. One session of SIPP training was carried out by the medic in the afternoon.

Total production 108.450 source kilometers.

Sunday 16th June.

A day interspersed with time-sharing with both Atlantic Explorer, and Veritas Vantage. Both vessels are able to handle each other shooting so they shoot together in one cycle whilst we shoot in the other.
We only have 3 lines left in this first swath plus a possible reshoot from the second sequence shot due to seismic interference so hopefully we can complete these in our next allocated slot.
The weather forecast does not look promising for the next few days but hopefully the conditions will not be so bad as to limit our recovery and redeployment of the cables on the second priority swath. The Explorer is due to finish tomorrow so we are hoping the weather will remain suitable so she can complete her survey. The on board medic carried out another training session today in SIPP.

Total production 84.350 source kilometers.

Monday 17th June.

We continued in a time-share today with both the Veritas Vantage and the Atlantic Explorer. News received in the morning indicates that the CGG vessel Foehn is coming to Norwegian block 7/1 in the next few days to shoot 800sqkm for Hydro. This should make things even more interesting as the Explorer is also due to move further South towards us tomorrow to do a small 3 day survey. Seq #1 and Seq#2 were re shot at the end of the prime source lines again due to seismic interference and the first swath of the prospect was completed mid evening. The weather picked up considerably at the end of the day and conditions were marginal to recover the cables. We commenced recovery of the Starboard cable after buoying off the Port cable and recovery continued through days end. Inlet was standing by our cable buoy position at the end of the day after recovering her arrays.

Total production 36.150 source kilometers.

Tuesday 18th June.
The PGS vessel Atlantic Explore lost a door last evening and has had to recover their equipment and proceeded into Stavanger for a replacement. Whilst this eases the time-share slightly the bad news is that they still have to come back out and complete their prospect.
Both of our cables were recovered early morning in marginal conditions and we prepared to relay on the second priority swath number 4. A failure on a power supply for the Port conveyor delayed the deployment whilst we trouble shot the fault and attempted to fix it. As it appeared that this was going to take some time we went ahead and deployed the Starboard cable first. A temporary solution was found to enable us to use the Port conveyor and we were able to use it after we had buoyed off the starboard cable.
Both cables were deployed and the vessel was in recording position late evening just in time for the Veritas Vantage to start shooting again.!. They are still shooting 5 to 6 hour lines on tidal cycles so we will come in for our turn when she finishes. The onboard medic carried out a training session today on CPR and the use of a defibrillator.

Wednesday 19th June.

A reasonable days production today. Veritas Vantage shut down during the day due to the weather allowing us to continue without interruption. The weather eased late in the evening and Vantage came back on line again so we went back into time share mode. Atlantic Explorer has still not come back out to the prospect after going into Stavanger yesterday however she is expected back on her block tomorrow.

Total Daily Production 96.400 Source kilometers.

Thursday 20th June.
An average day of production today having to time share with the Veritas Vantage. The PGS vessel Atlantic Explorer also arrived back on her prospect this afternoon and commenced shooting in the Vantages slot in the late evening.
The Geco Scorpio was taken along side this morning and transferred fresh provisions onboard and back loaded with cable sections for repair. Two new joiners for the vessel today, Party Manager Peter Shuttleworth joined the vessel for an extended handover period, and a replacement AB also joined. Inlet also had her FRC in the water as well transferring their Chief Navigator to the Scorpio for a break period before joining the Angler on the next crew rotation. Link interference caused a circle on the run-in to the last line of the day, this is definitely now related to skip wave reflection as today we had smooth sea conditions. When the weather is rougher we do not see the same interference pattern. 1 session of first aid training carried out today by the ships medic.

Total Production 78.400 Source Kilometers.

Friday 21st June

Another slow day with production interspersed with periods of time-share with the Veritas Vantage.
One sequence was also scratched due to ship noise from a supply boat at the Sleipner Platform. This swath will be completed tomorrow afternoon. Inlet will then recover her guns and proceed North up to the Diamond where she will carry out a quick undershoot. We will recover the cables and relay them on the last of the priority swaths number #6. Angler will then standby until the Inlet returns.
The ships medic visited Inlet today to assess what medical and crew QHSE minimum training needs to be carried out. It is our intention that he will travel back to Inlet again next week and remain on her for a few days to carry out the required training. 1 session of first aid training was carried out in the mess this evening: Topic immobilization of broken limbs.

Total production 78.4250 Source kilometers.

Saturday 22nd June
Completed the last three remaining lines of the second priority swath today, swath #4.
The Vantage took a fairly large time slot today of 7 hours so this put us back slightly in our timing to close out the swath. On completion of the swath the Inlet recovered their guns and proceeded to side scan the remaining receiver line for the block We had been informed early in the afternoon that she would now not be going to the Diamond today. This has been put back till mid week when we complete our next swath.Angler commenced recovering the cables; all went smoothly until the Starboard cable capstan developed some rather strange noises, sounding suspiciously like one of the bearings.We were able to bypass the capstan and continue, as it is not needed at this water depth, however we will investigate this further in the coming days. At end of the day the Angler was nearing completion of the recovery of the second cable. Inlet was standing by until we move to the next swath and continue laying.

Total Production 35.950 Source kilometers

Sunday 23rd June.

Both the seabed cables were re-laid on swath #6, the last of the priority swaths by early afternoon. Unfortunately the Veritas Vantage was in production and we were delayed several hours whilst we waited for her to finish so we could commence production.

The weather picked up later in the day and the noise levels must have been marginal for the towed streamer vessels. They continued in production however. We also saw some low level Seismic inference coming from the SW from a direction we had not seen any SI from before. Perhaps we have yet another player in the area.

Total production 48.000 Source Kilometers.

Monday 24th June.

Another slow day due to timeshare, Vantage requested extra time today to allow them to get past an FSU on tidal slots. We will gain extra time tomorrow to pick up the balance lost today.

The Navigators were able to extend the height of the 2 boat link antenna today after receiving a new roll of low loss cable. This had the effect of moving the link interference out of the period right at the start of line to a point about 800m on the run-in. This appears to work, however we have only completed 2 lines since this was done but both of these seem to indicate that this was successful.

Bad weather is forecast for tomorrow and whilst this may shut down the streamer boats it may also force Inlet to recover her arrays as the predicted winds and seas are quite extreme.

Total production 60.450 source kilometers.

Tuesday 25th June.

A poor day for production. During our first production slot we were able to complete three lines. The Inlet took the decision to recover there arrays based on the projected deteriorating weather forecast.

At the end of the day the weather conditions had moderated and Inlet were able to deploy the arrays. We then aimed to get one line in before Vantage started shooting again at 0140hrs utc.

Total production 36.150 source kilometers.

Wednesday 26th June.

The day continued with the operation in production however the Inlet was forced to circle, on the run into our first line after the Vantage's time slot, due to a gun problem. Fortunately Vantage went down for weather shortly after that and we were able to shoot uninterrupted for the remainder of the day.

The weather forecast for tomorrow looks very bad late in the late afternoon and early evening. As we only have two more prime lines and 1 small reshoot to complete for this swath we should be able to complete these and recover the cables before the weather deteriorates.

Total production 111.050 source kilometers.

Thursday 27th June

Weather conditions deteriorated enough to prevent the other vessels from acquiring data, hence no timesharing. Swath 6 was completed late in the morning and equipment recovery began.

A force 8 was forecast for the 28th with poor conditions predicted for a 24 hr period. The decision was taken to take both the Inlet and the Angler into Stavanger for bunkers and supplies.

The Inlet remained on prospect to guard cable 2 whilst the Angler recovered cable 1 after which she headed for Stavanger. The Angler followed the Inlet into Stavanger after completing recovery of the cables.

Total production 33.55 source kilometers.

Friday 28th June

Arrived Stavanger at 06:15 and commenced delivery of provisions and supplies.

The repaired workboat davit was installed and load tested. A service was carried out on the Dynamic Positioning system and the installation of the 2 boat link antenna was strengthened. The vessel departed Stavanger at 18:00.

Drug and Alcohol testing was carried out on the whole crew.

Saturday 29th June

In transit overnight back to the survey area. Conditions were rough initially but they started to moderate from 05:00. We commenced deploying cable 2 at 07:00.

Cables 1 and 2 laid and Inlet positioning runs completed by 18:41. One line was completed prior to starting to time-share with the Vantage.

Sunday 30th June

Remained in production but timesharing continued with the Veritas Vantage and the Atlantic Explorer. The Atlantic Explorer has now moved location closer to our location but she is still able to shoot alongside the Vantage. The Explorer has a small survey and expects to be in the area for 3-4 days.

The Inlet experienced gun problems on sequence 80 caused by cross feed due to leakage, which resulted in scratching sequence 81. The short line change time meant no time was available for repairs and several lines were shot before the problem was completely resolved.

Total production 84.325 source kilometers.

Monday 1st July

The Atlantic Explorer completed her survey late in the period and timeshare is now a two way split between the Angler and the Vantage. Weather conditions remain good and there were no technical problems.

Transferred the medic and one trainee to the Inlet with one trainee transferred from the Inlet to the Angler. The Medic will carry out SIP training on board the Inlet and the trainees will receive cross training.

Total production 89.400 source kilometers.

Tuesday 2nd July

Good production and weather conditions throughout the day. We were able to renegotiate the time-share to bring the swath completion forward by several hours. Swath 3 was completed at 23:00 hrs and the Inlet started to recover her arrays prior to being released to transit to the Geco Diamond.

Early evening we transferred the Inlet's trainee back onboard and the medic returned to the Angler. Paul Miller from the Angler has stayed onboard the Inlet to gain undershoot experience.

Chief's meeting held during which and vessel's performance against the QHSE plan was reviewed.

Total production 103.40 source kilometers.

Wednesday 3rd July

Following completion of swath 3 followed by QC checks we were able to release the Inlet at 00:15 hrs. The Inlet commenced her transit to join the Geco Diamond to carry out her undershoot.

The Angler started recovery prior to carrying out a swath move. Cable 1 was recovered first followed by cable 2. The vessel then moved to swath 2 and both cables were laid in position by 22:04 hrs.

The Angler is now standing by waiting for the Inlet to return.

Thursday 4th July

The Angler remains standing by waiting for the Inlet to return from her undershoot operation with the Geco Diamond

Modifications made to the COU in an attempt to improve its performance during recovery operations.

Friday 5th July

Standing by until 19:30 waiting for the Inlet to return from the Geco Diamond undershoot. Inlet's two-boat link needed reconfiguring back to the Angler-Inlet settings and support was contacted for assistance.

The Vantage was in production when the Inlet returned so positioning runs were carried out around cable 1. Production started at 23:02 hrs.

Total production 31.80 source kilometers.

Saturday 6th July

Good weather conditions but two lines scratched for ship noise. The Vantage is shooting lines close to platforms, which means she has to wait for the correct feather for each pass. This has restricted the times she has been able to shoot during the day.

Transferred the medic to the Western Inlet to carry out D&A testing on the crew. The samples will be sent ashore for analysis at the Inlet's crew change on the 10th July. Paul Miller rejoined the Angler following the undershoot and one trainee from the Inlet came onboard for additional training.

Total production 74.325 source kilometers.

Sunday 7th July

Good production early in the day but late morning a Statoil accommodation platform was towed into the area. The noise from the three tugs was sufficient to prevent us acquiring any further data for the remainder of the day. The platform is being positioned next to Sleipner A and estimates are that the work and noise levels will last for a 24-hour period.

Sequence 116 has a hole in the coverage due to a 2-boat link failure and sequence 118 was scratched due to gun problems onboard the Inlet.

The medic was transferred back to the Angler after completing D&A testing onboard the Inlet and the trainee navigator C.Amlacker rejoined the Inlet.

Total production 68.500 source kilometers.

Monday 8th July

No production due to excessive noise being generated by the accommodation platform being positioned at Sleipner A.

Shooting sequence 120 in an attempted to acquire data but this was later scratched.

Tuesday 9th July

Majority of the day spent on standby waiting for a reduction in the noise levels associated with positioning of the accommodation platform at Sleipner A. Obtaining regular updates from Sleipner but the schedule for completion constantly changing. Lining up for timeshare slots which we were unable to use. The platform positioning was eventually completed late evening and Angler was able to start production at 22:28 hrs.

The Geco Diamond started shooting during the afternoon and they are able to shoot at the same time as the Vantage. Early evening the Inlet test fired shots to allow the Vantage to monitor noise levels to see if we could shoot together, now that the Vantage has moved to the western edge of her survey. Unfortunately the noise levels are still to high so the Angler is now caught in a three-way timeshare.

One helicopter landed on the Angler during the afternoon bringing three crew members for the Inlet whilst two of Inlet's crew departed. The helicopter returned to Stavanger via the Diamond.

Total production 12.05 source kilometers.

Wednesday 10th July

A full days production but sequence 129 was scratched due to excessive noise from a passing tanker. Time-sharing continues with both the Veritas Vantage and the Geco Diamond.

Two helicopter flights carried out to the Angler to facilitate Inlet's crew-x. One flight was mid morning and the second flight was early evening. The Inlet's crew were transferred using Angler's MOB boat .

Total production 72.30 source kilometers.

Thursday 11th July

Time-sharing early in the period but able to complete swath 2 by 11:47. The last two lines were effected by ship noise caused by a supply vessel at Sleipner A. Recovered port streamer first followed by the starboard streamer prior to moving to swath 5. Commenced deploying cable 2 at 22:17.

One helicopter for Geco Diamond diverted to Geco Angler to change out one crew member from Western Inlet. Angler's MOB boat was used to transfer the personnel between the Angler and the Inlet.

Geco Angler held a crew QHSE meeting early in the afternoon.

Total production 54.075 source kilometers.

Friday 12th July

The deployment of the cables in swath 5 was completed by 08:48 after which there was a short period of timeshare before getting back into production. The Geco Diamond and Veritas Vantage are still in the area so the three-way timeshare continues. The Vantage informed us that the will soon start the undershoot phase of their survey.

Good weather conditions throughout the day with a good long term forecast.

Total production 60.125 source kilometers.

Saturday 13th July

Good weather conditions continue. The Veritas Vantage has now started the undershoot phase of her survey during which she will require 2-3 hour time slots. Initially this appeared to fit in well with the Diamond's 3 hour line length, however on the first pass we found the Diamond could no longer shoot alongside the Vantage. The Vantage tell us they have not moved position which means the source boat must be using a more powerful array. We are now back to a three way timeshare.

There were 2 boat link problems at the start of sequence 144 which caused a late start to the line. The failure was linked to the 2 boat antenna "dead zone" which lies approx 750m-1800m past the end of line on the eastern edge of the survey area.

Site Security Training carried out during the afternoon

Total production 85.825 source kilometers.

Sunday 14th July

The Diamond and Vantage attempted to shoot together at the start of the day without success. A three-way time share continued throughout the day.

Transferred the client and medic to the Western Inlet. The medic carried D&A testing on the Inlet's crew. Good weather conditions continue and the forecast looks favorable for the planned crew-x on the 17th.

Total production 58.675 source kilometers.

Monday 15th July

Good weather conditions continued throughout the period. The Diamond and Vantage found they were able to shoot together again once the Vantage had moved to the Southern end of her survey area. This resulted in quicker turn around times for all three vessels and we were able to complete the last line of swath 5 at 20:21. After waiting for client confirmation that the data was acceptable the Angler commenced recovery of cable 1.

The Inlet waited for the next available time slot to shoot a seabed test line that ran perpendicular to the survey lines. Statoil requested this line for testing the seabed transponders that were laid prior to the start of the survey.

Total production 84.250 source kilometers.

Tuesday 16th July

Cable recovery was completed at 07:30 after which the Angler commenced the transit to Block 34/10

The Inlet completed the seabed test line at 02:00 after which she departed for Block 34/10 (Gullfaxs) to carry out side scans of swath # 7.

7.4. Field Information and Encountered Problems

7.4.1. Obstructions / Installations on the Field

There were no fixed navigation hazards within the immediate vicinity of the survey area. The Sleipner A and Sleipner B platforms were 4.3 and 5.8 nautical miles from the centre of the prospect. There were two pipelines running in to the area, one was entrenched into the seabed and the other on
the surface - one used and the other disused. The pipelines were hazards that had to be taken into account when laying the cables.

7.4.2. Diving Operations

There were no diving operations within or around the area at the time the survey took place.

7.4.3. Traffic / Shipping Lanes

Whilst there were no shipping lanes running through the area passing tankers were seen each day. On several occasions data was scratched due to the tanker generated noise effecting data quality.

Supply vessels visited Sleipner A on a regular basis without causing problems. Unfortunately one supply vessel visited the platform every 10/12 days to pump water for 6/7 hours and this vessel did cause noise problems on those swaths closest to Sleipner A.

7.4.4. Fishing Activity

Fishing activity was minimal. Some purse-seiners were known to be in the area but after receiving co-ordinates for the location of the survey they stayed clear of the area. There was a fisheries rep onboard Geco Angler throughout the survey.

7.4.5. Seismic Interference and Time Share

Seismic interference was all around us - there was time sharing with 2 or 3 boats for the 1st 4 swathes, but moderate interference was evident on most lines from various directions. Vessels involved in timesharing at different stages of the survey were Veritas Vantage, Atlantic Explorer and Geco Diamond.

7.4.6. Environmental Obstacles

This survey was shot during the North Sea summer season.

The survey started with marginal weather and rough seas seas, but then became a mixture of one to two days of reasonable weather (5-15 knots) interspersed frequently with one to two day periods of 15 to 30 knots. We experienced a storm in the second week with Southerly winds gusting to 45 knots and 6 m seas. For the remainder of the survey we experienced excellent weather conditions with fine sunny skies and little wind and sea conditions.

7.4.7. Operational Observations

The seabed did not cause any damage to the cables.

One of the pipelines on the seabed, created a noise problem for some of the geophone groups in the X, Y & Z sections of the cables.

8. HSE Summary

There were no significant HSE incidents during the survey.
Drills were held every weekend.
General Safety meetings were held at the start and end of every trip.
Reporting levels were high.
Small boat usage was minimal.
All significant Incident Reports were included in the Schlumberger QUEST database.

ITEM	Geco Angler	Western Inlet
HSE Meetings	2	6
LPT Meetings	2	3
IRs (incl STOP etc.)	65	42
Audits	7	1
Drills	6	5
LTIs	0	0

9. Shipment List

Shipment Number yyy-yy mmn zs ttt	Date <new	Dept	Description Attention shipment numbers changed from No: 071	shipped to	Date sent
ang-02 cd 118 eam	26.jun.02	OBP	Nav. Merged tapes for AN9238DP (Swaths 01, 04 & 06)	WG-Stavanger	26.jun.02
ang-02 ad 119 dpr	16.jun.02	NS	Original data 9238 seq. 001 to 077	WG-Stavanger	28.jun.02
ang-02 ad 120 spe	09.jul.02	NS	Copy data 9238 seq. 001 to 161	Statoil Tape Storage	30.jul.02
ang-02 ad 121 dpr	09.jul.02	NS	Original data 9238 seq. 078 to 161	WG-Stavanger	30.jul.02
ang-02 cd 122 nor	10.jul.02	OBP	SEG-Y merged tapes for 9238 swath 03	WG-Stavanger	10.jul.02
ang-02 pd 126 eam	09.jun.02	NAV	Data shipment Job 9238 seq 001-236	WG-Stavanger	22.jul.02
ang-02 pd 127 eam	09.jun.02	NAV	Data shipment Job 9238 seq 001-236	Statoil Tape Storage	22.jul.02
ang-02 pd 128 eam	09.jun.02	NAV	Data shipment Job 9238 seq 001-236	WG-Gatwick	22.jul.02
ang-02 131 cd stv	15.jul.02	OBP	SEG-Y merged tapes for 9238 swath 02 & 05	WG-Stavanger	22.jul.02
ang-02 133 ad stv	16.jun.02	QC	Paper brute stack plots and CD with .gifs for VOLVE (an9238).	WG-Stavanger	22.jul.02
ang-02 135 ad dpr	16.jul.02	NS	Petrobank Files for STATOIL, job: 9238 without disk (to be resend)	Petro Data A/S	30.jul.02
ang-02 148 ad dpr	02.aug.02	NS	Petrobank Files for STATOIL, job: 9238	Petro Data A/S	

ANG-02OD118-EAM	NAV merged 4C data Seq 078-103	WesternGeco PO Box 8013 Stavanger N-4003 Norway
ANG-02AD119-DPR	Seismic Data Tapes - original Paperwork & Tape logs Sequence 1 - 77	WesternGeco PO Box 8013 Stavanger N-4003 Norway Attn: Paul Doyle
ANG-02AD120-DPR		
ANG-02AD121-DPR	Seismic Data Tapes - original Paperwork & Tape logs Sequence 78 - 161	WesternGeco PO Box 8013 Stavanger N-4003 Norway Attn: Paul Doyle
ANG-02OD122-NOR	NAV merged 4C data Seq 003-077	WesternGeco PO Box 8013 Stavanger N-4003 Norway Attn: Paul Doyle
ANG-02PD125-EAM	3590 Tape No BOAT001 SPS, P294, P1V, P1S 1 * CD Rom Seq 001 to 005	Schlumberger House Buckingham Gate Gatwick Airport West Sussex RH6 ONZ Attn: Piere Morley
ANG-02PD126-EAM	3590 Tape No ST0202SPS001	WesternGeco PO Box 8013 Stavanger N-4003 Norway Attn: Paul Doyle
ANG-02PD127-DPR	3590 Tape No ST0202SPS001 3590 Tape No ST0202R001 3590 Tape No ST0202VP001	Statoil Tape Storage Norsk Geodata Senter Hydro Industipark N-3670 Notodden Norway Attn: Gry Dybedal

ANG-02PD128-EAM	3590 Tape No BOAT002 SPS, P294, P1V, P1S 1 * CD Rom	Schlumberger House Buckingham Gate Gatwick Airport West Sussex RH6 ONZ Attn: Piere Morley
ANG-02131OD-NOR	NAV merged 4C data Seq 104-161	WesternGeco PO Box 8013 Stavanger N-4003 Norway Attn: Paul Doyle
ANG-02133AD-NOR	Paper plots of brute stacks CD containing TrilogyQC .gifs, sheet, production log, observers logs, noise Seq 001-161	WesternGeco PO Box 8013 Stavanger N-4003 Norway Attn: Paul Doyle
ANG-02148AD-DPR	Petrofiles for job 9238	Petro Data A/S Prof Olav Hansensvei13 Postboks 585, Madla N-4040 Hafrsfjord NORWAY

10. Logs

Seismic Tape Logs

STATOIL Project #:	ST0202																		
Line prefix:	S0202																		
Comment ->					*Tape ID and shotpoint range stored on the actual tape*			*To be used if dual recording and shotpoint numbers are not equal to the original tape*			*Tape ID and shotpoint range stored on the actual tape*								
Tape type ->					Original Seismic tape			Dual recorded seismic tape			P2/94 tape			SPS tape			P1/90 Vessel position Processed water depth		
Line ID					Tape ID	FSP	LSP	Tape ID	FSP	LSP	Tape ID as specified in Contract	FSP	LSP	Tape ID as specified in Contract	FSP	LSP	Tape ID as specified in Contract	FSP	LSP
Source/ Receiver line identifier "S" or "R"	Swath number ##	Shot code "P" for prime then "A", "B" ...	line# XXXX	seq. # $$$															
S	1	P	1002	1	Contractor Tape-ID	5001	5850	Contractor Tape-ID	5001	5830	ST0202R000	4991	5850	ST0202SPS000	5001	5850	ST0202VP000	5001	5850
S	1	P	S01P5019001	001	1	1760	2536	1001	1760	2536	Scratched			Scratched			Scratched		
S	1	P	S01P5019001	001	2	2538	2722	1002	2538	2722	Scratched			Scratched			Scratched		
S	1	P	S01P5015002	002	3	2722	1950	1003	2772	1950	Scratched			Scratched			Scratched		
S	1	P	S01P5015002	002	4	1948	1760	1004	1948	1760	Scratched			Scratched			Scratched		
S	1	P	S01P5023003	003	5	1760	2538	1005	1760	2538	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P5023003	003	6	2540	2722	1006	2540	2722									
S	1	P	S01P5011004	004	7	2722	1940	1007	2722	1940	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P5011004	004	8	1938	1760	1008	1938	1760									
S	1	P	S01P5035005	005	9	1760	2532	1009	1760	2532	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P5035005	005	10	2534	2606	1010	2534	2606									
S	1	P	S01P5035005	005	11	2608	2722	1011	2608	2722									
S	1	P	S01P5003006	006	12	2722	1948	1012	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P5003006	006	13	1946	1760	1013	1946	1760									
S	1	P	S01P5007007	007	14	1760	2538	1014	1760	2538	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P5007007	007	15	2540	2722	1015	2540	2722									
S	1	P	S01P5031008	008	16	2722	1948	1016	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P5031008	008	17	1946	1760	1017	1946	1760									
S	1	P	S01P4999009	009	18	1760	2536	1018	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P4999009	009	19	2538	2722	1019	2538	2722									
S	1	P	S01P5027010	010	20	2722	1946	1020	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P5027010	010	21	1944	1760	1021	1944	1760									
S	1	P	S01P4995011	011	22	1760	2536	1022	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P4995011	011	23	2538	2722	1023	2538	2722									
S	1	P	S01P4991012	012	24	2722	1946	1024	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P4991012	012	25	1944	1944	1025	1944	1760									
S	1	P	S01P4991012	012	26	1942	1760	1026	NOR	NOR									
S	1	P	S01P4991013	013	27	1760	2534	1027	1760	2534	ST0202R001	1740	2744	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P4991013	013	28	2536	2722	1028	2536	2722									
S	1	P	S01P4963014	014	29	2722	2630	1029	2722	2648	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P4963014	014	30	2628	1848	1030	2646	1948									

S	1	P	S01P4963014	014	31	1846	1760	1031	1846	1760									
S	1	P	S01P4987015	015	32	1760	2536	1032	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P4987015	015	33	2538	2722	1033	2538	2722									
S	1	P	S01P5043016	016	34	2722	1948	1034	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P5043016	016	35	1946	1760	1035	1946	1760									
S	1	P	S01P4963017	017	36	1760	2538	1036	1760	2538	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P4963017	017	37	2540	2722	1037	2540	2722									
S	1	P	S01P5047018	018	38	2722	1946	1038	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P5047018	018	39	1948	1760	1039	1948	1760									
S	1	P	S01P4947019	019	40	1760	2538	1040	1760	2538	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P4947019	019	41	2540	2722	1041	2540	2722									
S	1	P	S01P5051020	020	42	2722	1948	1042	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P5051020	020	43	1946	1760	1043	1946	1760									
S	1	P	S01P4979021	021	44	1760	2368	1044	1760	2348	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P4979021	021	45	2368	2722	1045	2350	2722									
S	1	P	S01P4971022	022	46	2722	1948	1046	2722	1948	ST0202R001	2744	1742	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P4971022	022	47	1946	1760	1047	1946	1760									
S	1	P	S01P5055023	023	48	1760	2534	1048	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P5055023	023	49	2536	2722	1049	2536	2722									
S	1	P	S01A5015024	024	50	2722	1948	1050	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01A5015024	024	51	1946	1760	1051	1946	1760									
S	1	P	S01P4975025	025	52	1760	2534	1052	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	1	P	S01P4975025	025	53	2536	2722	1053	2536	2722									
S	1	P	S01P5019026	026	54	2722	1946	1054	2722	2346	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	1	P	S01P5019026	026	55	1944	1760	1055	2344	1760									
S	4	P	S04P5103027	027	56	1760	2534	1056	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	4	P	S04P5103027	027	57	2536	2722	1057	2536	2722									
S	4	P	S04P5071028	028	58	2722	2544	1058	2722	2538	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5071028	028	59	2542	1924	1059	2536	1912									
S	4	P	S04P5071028	028	60	1922	1760	1060	1910	1760									
S	4	P	S04P5099029	029	61	1760	2536	1061	1760	2536	ST0202R001	1744	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	4	P	S04P5099029	029	62	2538	2722	1062	2538	2722									
S	4	P	S04P5063030	030	63	2722	1948	1063	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5063030	030	64	1946	1760	1064	1946	1760									
S	4	P	S04P5095031	031	65	1760	2544	1065	1760	2544	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	4	P	S04P5095031	031	66	2546	2722	1066	2546	2722									
S	4	P	S04P5067032	032	67	2722	1948	1067	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5067032	032	68	1946	1760	1068	1946	1760									
S	4	P	S04P5091033	033	69	1760	2534	1069	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	4	P	S04P5091033	033	70	2536	2722	1070	2536	2722									
S	4	P	S04P5087034	034	71	2722	1948	1071	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5087034	034	72	1946	1760	1072	1946	1760									
S	4	P	S04P5059035	035	73	1760	2538	1073	1760	2538	ST0202R001	1742	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	4	P	S04P5059035	035	74	2540	1760	1074	2540	1760									
S	4	P	S04P5111036	036	75	2722	1946	1075	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5111036	036	76	1944	1760	1076	1944	1760									
S	4	P	S04P5079037	037	77	1760	2536	1077	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722

S	4	P	S04P5079037	037	78	2538	2722	1078	2538	2722									
S	4	P	S04P5107038	038	79	2722	1946	1079	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5107038	038	80	1944	1760	1080	1944	1760									
S	4	P	S04P5079039	039	81	1760	2540	1081	1760	2540	ST0202R001	1740	2734	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	4	P	S04P5079039	039	82	2542	2722	1082	2542	2722									
S	4	P	S04P5115040	040	83	2722	1946	1083	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5115040	040	84	1944	1760	1084	1944	1760									
S	4	P	S04P5083041	041	85	1760	2534	1085	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	4	P	S04P5083041	041	86	2536	2722	1086	2536	2722									
S	4	P	S04P5119042	042	87	2722	1948	1087	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5119042	042	88	1946	1760	1088	1946	1760									
S	4	P	S04P5143043	043	89	1774	2558	1089	1774	2558	Scratched			Scratched			Scratched		
S	4	P	S04P5143043	043	90	2560	2722	1090	2560	2722									
S	4	P	S04P5123044	044	91	2722	1948	1091	2722	1948	ST0202R001	2742	1736	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5123044	044	92	1946	1760	1092	1946	1760									
S	4	P	S04P5147045	045	93	1762	2546	1093	1762	2546	ST0202R001	1746	2742	ST0202SPS001	1762	2724	ST0202VP001	1762	2724
S	4	P	S04P5147045	045	94	2548	2724	1094	2548	2724									
S	4	P	S04P5127046	046	95	2722	1946	1095	2722	2264	ST0202R001	2742	1752	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5127046	046	96	1944	1760	1096	2262	1760									
S	4	P	S04P5151047	047	97	1810	2558	1097	1810	2558	ST0202R001	1806	2764	ST0202SPS001	1810	2744	ST0202VP001	1810	2744
S	4	P	S04P5151047	047	98	2560	2744	1098	2560	2744									
S	4	P	S04P5139048	048	99	2722	2062	1099	2722	2024	ST0202R001	2742	1760	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5139048	048	100	2060	1768	1100	2022	1768									
S	4	P	S04P5131049	049	101	2722	1944	1101	2722	1944	ST0202R001	2742	1760	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	4	P	S04P5131049	049	102	1942	1766	1102	1942	1766									
S	4	P	S04A5143050	050	103	1774	2552	1103	1774	2552	ST0202R001	1762	2742	ST0202SPS001	1774	2734	ST0202VP001	1774	2734
S	4	P	S04A5143050	050	104	2554	2734	1104	2554	2734									
S	4	P	S04P5135051	051	105	2722	1948	1105	2722	1948	ST0202R001	2742	1750	ST0202SPS001	2722	1760	ST0202VP001	2722	1768
S	4	P	S04P5135051	051	106	1946	1768	1106	1946	1768									
S	6	P	S06P5171052	052	107	2722	2668	1107	2722	2656	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5171052	052	108	2666	1880	1108	2654	1856									
S	6	P	S06P5171052	052	109	1878	1760	1109	1854	1760									
S	6	P	S06P5195053	053	110	1760	2526	1110	1760	2538	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5195053	053	111	2528	2722	1111	2540	2722									
S	6	P	S06P5175054	054	112	2722	1948	1112	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5175054	054	113	1946	1760	1113	1946	1760									
S	6	P	S06P5199055	055	114	1760	2536	1114	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5199055	055	115	2538	2722	1115	2538	2722									
S	6	P	S06P5179056	056	116	2722	1946	1116	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5179056	056	117	1944	1760	1117	1944	1760									
S	6	P	S06P5203057	057	118	1760	2536	1118	1760	2536	ST0202R001	1760	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5203057	057	119	2538	2722	1119	2538	2722									
S	6	P	S06P5183058	058	120	2722	1948	1120	2722	1948	ST0202R001	2742	1730	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5183058	058	121	1946	1760	1121	1946	1760									
S	6	P	S06P5163059	059	122	1760	1834	1122	1760	1842	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5163059	059	123	1836	2634	1123	1844	2336									
S	6	P	S06P5163059	059	124	2638	2722	1124	2338	2722									

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S	6	P	S06P5139060	060	125	2722	1948	1125	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5139060	060	126	1946	1760	1126	1946	1760									
S	6	P	S06P5167061	061	127	1760	2532	1127	1760	2532	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5167061	061	128	2534	2722	1128	2534	2722									
S	6	P	S06P5136062	062	129	2722	2042	1129	2722	2050	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5136062	062	130	2040	1760	1130	2048	1760									
S	6	P	S06P5159063	063	131	1760	1776	1131	1760	1754	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5159063	063	132	1778	2554	1132	1756	2554									
S	6	P	S06P5159063	063	133	2556	1760	1133	2556	1760									
S	6	P	S06P5143064	064	134	2722	1950	1134	2722	1950	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5143064	064	135	1948	1760	1135	1948	1760									
S	6	P	S06P5123065	065	136	1760	1784	1136	1760	1784	Scratched			Scratched			Scratched		
S	6	P	S06A5123066	066	137	1760	2244	1137	1760	2250	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06A5123066	066	138	2246	2272	1138	2252	2272									
S	6	P	S06P5147067	067	139	2722	1946	1139	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5147067	067	140	1944	1760	1140	1944	1760									
S	6	P	S06P5127068	068	141	1760	2534	1141	1760	2210	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5127068	068	142	2536	2722	1142	2212	2722									
S	6	P	S06P5151069	069	143	2722	1946	1143	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5151069	069	144	1944	1760	1144	1944	1760									
S	6	P	S06P5131070	070	145	1760	1818	1145	1760	2538	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5131070	070	146	1820	2620	1146	2540	2722									
S	6	P	S06P5131070	070	147	2622	2722	1147	NDR	NDR									
S	6	P	S06P5156071	071	148	2722	1946	1148	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5156071	071	149	1944	1760	1149	1944	1760									
S	6	P	S06P5207072	072	150	1760	2550	1150	1760	2550	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5207072	072	151	2552	2722	1151	2552	2722									
S	6	P	S06P5187073	073	152	2722	1948	1152	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5187073	073	153	1946	1760	1153	1946	1760									
S	6	P	S06P5211074	074	154	1760	2536	1154	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5211074	074	155	2538	1760	1155	2538	1760									
S	6	P	S06B5123075	075	156	2384	2522	1156	2384	2522	ST0202R001	2364	2542	ST0202SPS001	2384	2522	ST0202VP001	2384	2522
S	6	P	S06P5191076	076	157	2722	1946	1157	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	6	P	S06P5191076	076	158	1944	1760	1158	1944	1760									
S	6	P	S06P5215077	077	159	1760	2534	1159	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	6	P	S06P5215077	077	160	2536	2604	1160	2536	2596									
S	6	P	S06P5215077	077	161	2608	1760	1161	2598	1760									
S	3	P	S03P5087078	078	162	2722	1948	1162	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5087078	078	163	1946	1760	1163	1946	1760									
S	3	P	S03P5079079	079	164	2722	1948	1164	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5079079	079	165	1946	1760	1165	1946	1760									
S	3	P	S03P5103080	080	166	1760	2536	1166	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5103080	080	167	2538	2722	1167	2538	2722									
S	3	P	S03P5075081	081	168	2722	1940	1168	2722	1940	Scratched			Scratched			Scratched		
S	3	P	S03P5075081	081	169	1938	2532	1169	1938	2532	Scratched			Scratched			Scratched		
S	3	P	S03P5099082	082	170	1760	2492	1170	1760	2492	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5083083	083	171	2722	1948	1171	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760

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S	3	P	S03P5083083	083	172	1946	1760	1172	1946	1760									
S	3	P	S03P5075084	084	173	1760	1922	1173	1760	1918	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5076084	084	174	1924	2722	1174	1920	2718									
S	3	P	S03P5079084	084	175	2724	2742	1175	2720	2722									
S	3	P	S03P5107085	085	176	2722	2328	1176	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5107085	085	177	2326	1760	1177	1944	1760									
S	3	P	S03P5119086	086	178	1762	2548	1178	1762	2234	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5119086	086	179	2550	2722	1179	2236	2722									
S	3	P	S03A5099087	087	180	2494	2722	1180	2494	2722	ST0202R001	2454	2742	ST0202SPS001	2474	2722	ST0202VP001	2474	2722
S	3	P	S03P5096088	088	182	2722	1940	1182	2722	1940	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5096088	088	183	1938	1760	1183	1938	1760									
S	3	P	S03P5067089	089	184	1760	2534	1184	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5067089	089	185	2536	2722	1185	2536	2722									
S	3	P	S03P5043090	090	186	2722	2344	1186	2722	2348	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5043090	090	187	2342	1760	1187	2346	1760									
S	3	P	S03P5071091	091	188	1760	2536	1188	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5071091	091	189	2538	2722	1189	2538	2722									
S	3	P	S03P5047092	092	190	2722	1948	1190	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5047092	092	191	1946	1760	1191	1946	1760									
S	3	P	S03P5063093	093	192	1760	2536	1192	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5063093	093	193	2538	2722	1193	2538	2722									
S	3	P	S03P5039094	094	194	2722	1948	1194	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5039094	094	195	1946	1760	1195	1946	1760									
S	3	P	S03P5059095	095	196	1760	2534	1196	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5059095	095	197	2536	2722	1197	2536	2722									
S	3	P	S03P5027096	096	198	2722	1948	1198	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5027096	096	199	1946	1760	1199	1946	1760									
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S	3	P	S03P5055097	097	201	2536	2722	1201	2536	2722									
S	3	P	S03P5031098	098	202	2722	1948	1202	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	3	P	S03P5031098	098	203	1946	1760	1203	1946	1760									
S	3	P	S03P5051099	099	204	1760	2538	1204	1760	2538	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5051099	099	205	2540	2722	1205	2540	2722									
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S	3	P	S03P5035100	100	207	1946	1760	1207	1946	1760									
S	3	P	S03P5111101	101	208	1760	2538	1208	1760	2416	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5111101	101	209	2540	2722	1209	2418	2722									
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S	3	P	S03P5091102	102	211	1946	1760	1211	1946	1760									
S	3	P	S03P5115103	103	212	1760	2216	1212	1760	2208	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	3	P	S03P5116103	103	213	2218	2722	1213	2210	2722									
S	2	P	S02P5051104	104	214	2722	1950	1214	2722	1950	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5051104	104	215	1948	1760	1215	1948	1760									
S	2	P	S02P5075105	105	216	1760	2536	1216	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	2	P	S02P5075105	105	217	2538	2722	1217	2538	2722									
S	2	P	S02P5047106	106	218	2722	2468	1218	2722	2454	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5047106	106	219	2466	1760	1219	2452	1766									

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S	2	P	S02P5047106	106	220	1758	1740	1220	1764	1740								
S	2	P	S02P5071107	107	221	1760	2540	1221	1760	2540	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	2	P	S02P5071107	107	222	2542	2722	1222	2542	2722								
S	2	P	S02P5035108	108	223	2722	2440	1223	2722	2440	Scratched			Scratched			Scratched		
S	2	P	S02A5035109	109	224	1760	2536	1224	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	2	P	S02A5035109	109	225	2538	2722	1225	2538	2722								
S	2	P	S02P5059110	110	226	2722	1948	1226	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5059110	110	227	1946	1760	1227	1946	1760								
S	2	P	S02P5031111	111	228	1760	2534	1228	1760	2534	Scratched			Scratched			Scratched		
S	2	P	S02P5031111	111	229	2536	2722	1229	2536	2722	Scratched			Scratched			Scratched		
S	2	P	S02P5007112	112	230	2722	1942	1230	2722	1942	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5007112	112	231	1940	1760	1231	1940	1760								
S	2	P	S02P5039113	113	232	1760	2552	1232	1760	2552	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	2	P	S02P5039113	113	233	2554	2722	1233	2554	2722								
S	2	P	S02P5063114	114	234	2722	1940	1234	2722	1940	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5063114	114	235	1938	1760	1235	1938	1760								
S	2	P	S02A5031115	115	236	1760	2542	1236	1760	2542	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	2	P	S02A5031115	115	237	2544	2722	1237	2544	2722								
S	2	P	S02P5003116	116	238	2722	1896	1238	2722	1896	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5003116	116	239	1892	1734	1239	1892	1734								
S	2	P	S02P5027117	117	240	1760	2536	1240	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	2	P	S02P5027117	117	241	2538	2722	1241	2538	2722								
S	2	P	S02P4999118	118	242	2722	2196	1242	2722	2196	ST0202R001	2742	2200	ST0202SPS001	2722	2230	ST0202VP001	2722	2230
S	2	P	S02P5023119	119	243	1760	2514	1243	1760	2514	Scratched			Scratched			Scratched		
S	2	P	S02P5023119	119	244	2516	2722	1244	2516	2722	Scratched			Scratched			Scratched		
S	2	P	S02P4995120	120	245	2722	1950	1245	2722	1950	Scratched			Scratched			Scratched		
S	2	P	S02P4995120	120	246	1948	1760	1246	1948	1760	Scratched			Scratched			Scratched		
S	2	P	S02A4995121	121	247	1760	2230	1247	1760	2230	Scratched			Scratched			Scratched		
S	2	P	S02B4995122	122	248	2722	1948	1248	2722	1948	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02B4995122	122	249	1946	1760	1249	1946	1760								
S	2	P	S02P5019123	123	250	1760	2534	1250	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	2	P	S02P5019123	123	251	2536	2722	1251	2536	2722								
S	2	P	S02P5043124	124	252	2722	1944	1252	2722	1944	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5043124	124	253	1942	1760	1253	1942	1760								
S	2	P	S02P5011125	125	254	2722	1946	1254	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5011125	125	255	1944	1760	1255	1944	1760								
S	2	P	S02P5067126	126	256	1760	2548	1256	1760	2548	ST0202R001	1740	2742	ST0202SPS001	1762	2722	ST0202VP001	1762	2722
S	2	P	S02P5067126	126	257	2550	2722	1257	2550	2722								
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S	2	P	S02P5015127	127	259	1944	1760	1259	1944	1760								
S	2	P	S02A5003128	128	260	2118	1988	1260	2118	1988	ST0202R001	2138	1968	ST0202SPS001	2118	1988	ST0202VP001	2118	1988
S	2	P	S02A5023129	129	261	1760	2540	1261	1760	2540	Scratched			Scratched			Scratched		
S	2	P	S02B5023130	130	262	2722	1940	1262	2722	1940	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02B5023130	130	263	1938	1760	1263	1938	1760								
S	2	P	S02A4999131	131	264	2248	2174	1264	2248	2164	ST0202R001	2268	1740	ST0202SPS001	2248	1760	ST0202VP001	1760	2722
S	2	P	S02A4999131	131	265	2172	1760	1265	2162	1760								
S	2	P	S02P5079132	132	266	1760	2540	1266	1760	2540	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722

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S	2	P	S02P5079132	132	267	2542	2722	1267	2542	2722									
S	2	P	S02P5087133	133	268	2722	1946	1268	2722	1946	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5087133	133	269	1944	1760	1269	1944	1760									
S	2	P	S02P5055134	134	270	1760	2536	1270	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	2	P	S02P5055134	134	271	2538	2722	1271	2538	2722									
S	2	P	S02P5063135	135	272	2722	1938	1272	2722	1938	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	2	P	S02P5063135	135	273	1936	1760	1273	1936	1760									
S	5	P	S05P5147136	136	274	1760	2532	1274	1760	2532	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	5	P	S05P5147136	136	275	2534	2722	1275	2534	2722									
S	5	P	S05P5171137	137	276	2722	1940	1276	2722	1940	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5171137	137	277	1938	1760	1277	1938	1760									
S	5	P	S05P5143138	138	278	1760	2536	1278	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1770	2722	ST0202VP001	1770	2722
S	5	P	S05P5143138	138	279	2538	2722	1279	2538	2722									
S	5	P	S05P5167139	139	280	2722	1936	1280	2722	2056	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5167139	139	281	1934	1760	1281	2054	1760									
S	5	P	S05P5139140	140	282	1760	2534	1282	1760	2534	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	5	P	S05P5139140	140	283	2536	2722	1283	2536	2722									
S	5	P	S05P5151141	141	284	2722	2034	1284	2722	2046	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5151141	141	285	2032	1760	1285	2044	1760									
S	5	P	S05P5179142	142	286	1760	2230	1286	1760	2224	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	5	P	S05P5179142	142	287	2232	2722	1287	2226	2722									
S	5	P	S05P5155143	143	288	2722	1938	1288	2722	1932	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5155143	143	289	1936	1760	1289	1930	1760									
S	5	P	S05P5131144	144	290	NDR		1290	NDR		Scratched			Scratched			Scratched		
S	5	P	S05P5131145	145	291	1902	2712	1291	1902	2712	ST0202R001	1882	2742	ST0202SPS001	1902	2722	ST0202VP001	1902	2722
S	5	P	S05P5131145	145	292	2714	2722	1292	2714	2722									
S	5	P	S05P5107146	146	293	2722	1930	1293	2722	1930	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5107146	146	294	1928	1760	1294	1928	1760									
S	5	P	S05P5135147	147	295	1760	2536	1295	1760	2536	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	5	P	S05P5135147	147	296	2538	2722	1296	2538	2722									
S	5	P	S05P5111148	148	297	2722	1942	1297	2722	1942	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5111148	148	298	1940	1760	1298	1940	1760									
S	5	P	S05P5127149	149	299	1768	2548	1299	1768	2548	ST0202R001	1740	2742	ST0202SPS001	1768	2722	ST0202VP001	1768	2722
S	5	P	S05P5127149	149	300	2550	2722	1300	2550	2722									
S	5	P	S05P5099150	150	301	2722	1944	1301	2722	1944	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5099150	150	302	1942	1760	1302	1942	1760									
S	5	P	S05P5123151	151	303	1760	2542	1303	1760	2542	ST0202R001	1740	2742	ST0202SPS001	1760	2722	ST0202VP001	1760	2722
S	5	P	S05P5123151	151	304	2544	2722	1304	2544	2722									
S	5	P	S05P5095152	152	305	2722	1940	1305	2722	1940	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5095152	152	306	1938	1760	1306	1938	1760									
S	5	P	S05B5131153	153	307	1760	1920	1307	1760	1920	ST0202R001	1740	1940	ST0202SPS001	1760	1920	ST0202VP001	1760	1920
S	5	P	S05B5103154	154	308	2722	1944	1308	2722	1944	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05B5103154	154	309	1942	1760	1309	1942	1760									
S	5	P	S05P5115155	155	310	1768	2562	1310	1768	2562	ST0202R001	1752	2742	ST0202SPS001	1768	2722	ST0202VP001	1768	2722
S	5	P	S05P5115155	155	311	2564	2722	1311	2564	2722									
S	5	P	S05P5091156	156	312	2722	1934	1312	2722	1934	ST0202R001	2742	1740	ST0202SPS001	2722	1760	ST0202VP001	2722	1760
S	5	P	S05P5091156	156	313	1932	1760	1313	1932	1760									

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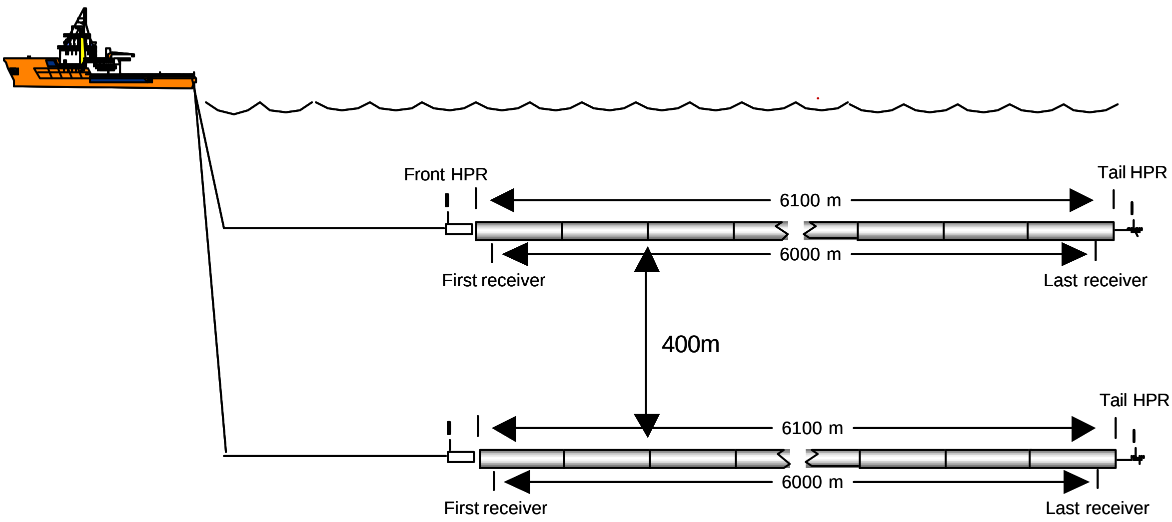
S	5	P	S05P5119157	157	314	1760	2544	1314	1760	2544	ST0202RC001	1740	2742	ST0202SPS001	1760	2722	STC202VP001	1760	2722
S	5	P	S05P5119157	157	315	2546	2722	1315	2546	2722									
S	5	P	S05P5159158	158	316	2722	1940	1316	2722	1940	ST0202RC001	2742	1740	ST0202SPS001	2722	1760	STC202VP001	2722	1760
S	5	P	S05P5159158	158	317	1938	1760	1317	1938	1760									
S	5	P	S05P5175159	159	318	1760	2544	1318	1760	2544	ST0202RC001	1740	2742	ST0202SPS001	1760	2722	STC202VP001	1760	2722
S	5	P	S05P5175159	159	319	2546	2722	1319	2546	2722									
S	5	P	S05P5163160	160	320	2742	1944	1320	2742	2266	ST0202RC001	2742	1740	ST0202SPS001	2722	1760	STC202VP001	2722	1760
S	5	P	S05P5163160	160	321	1942	1760	1321	2264	1760									
S	5	P	S05P5183161	161	322	1760	2542	1322	1760	2542	ST0202RC001	1740	2742	ST0202SPS001	1760	2722	STC202VP001	1760	2722
S	5	P	S05P5183161	161	323	2544	2722	1323	2544	2722									
S	5	P																	
S	5	P																	
S	5	P																	
S	5	P																	
S	5	P																	

Equipment Configuration

11. Cable Configuration

11.1. Cable Layout 4C



12. Cable Parameters

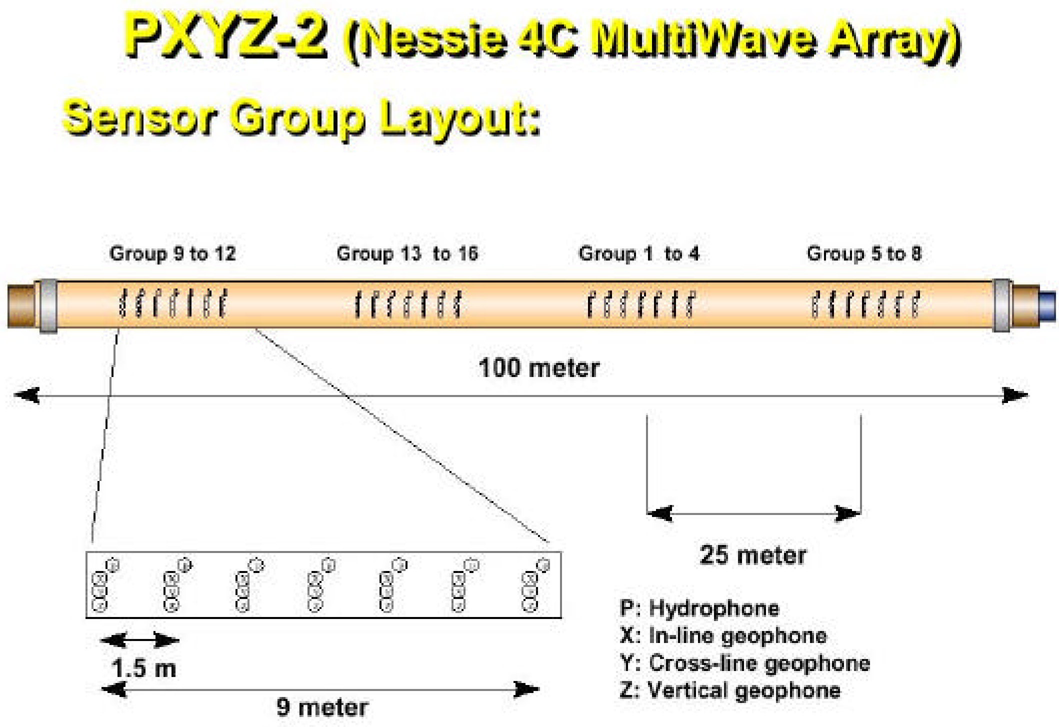
12.1. Cable System Description

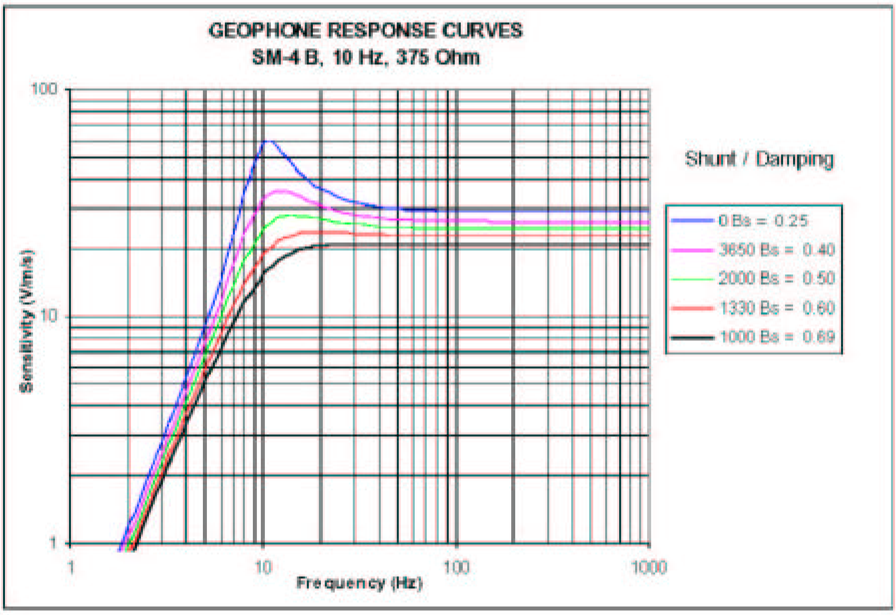
Cable System Parameters	
Number of Cables	2
Type of Cable	MWA-4C Digital N4
Cable length	6100m / 6000m active
Groups per Cable	960 / P,X,Y,Z
Group intervals	25 m for each component
Outside diameter	67mm
Jacket (type-thickness)	Polyurethane, 3.5 mm
Breaking strength	100 kN
Ballast fluid (fluid-quantity)	Isopar M, 250l
Connectors (diameter-length)	Max. Dia 68 mm, length 251 mm
Channels per module	16
Data transmission link	Differential twisted pair
Power	60 – 300 V AC
Leakage	> 1 Mohm
Active group lengths	9.0 m
Nearest offset available	N/A
Cable depth	Sea bottom
Cable separation	400 m

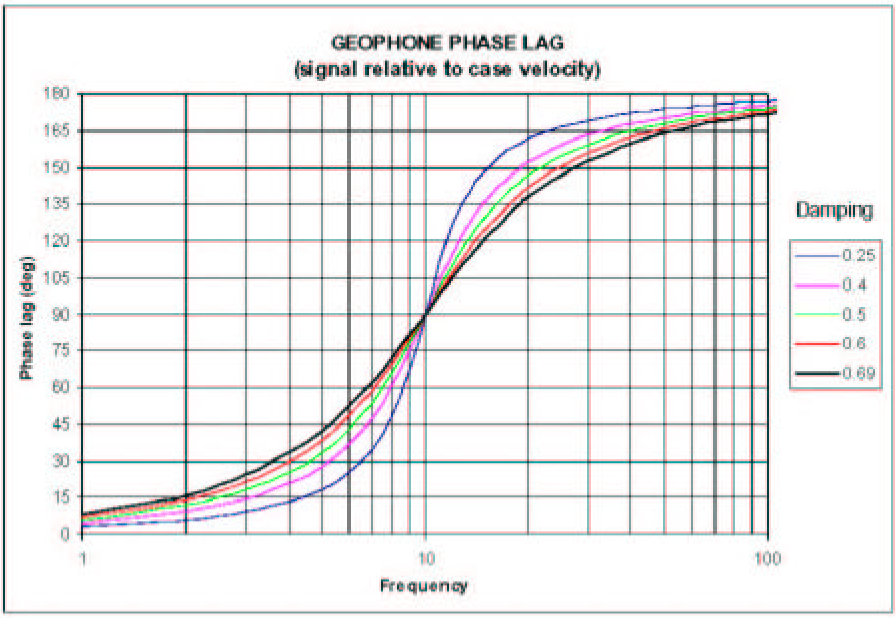
Trace allocation 3D	Location	Near	Far
Cable 1 P component	N/A	5	244
Cable 1 X component	N/A	249	488
Cable 1 Y component	N/A	493	732
Cable 1 Z component	N/A	737	976
Cable 2 P component	N/A	981	1220
Cable 2 X component	N/A	1225	1464
Cable 2 Y component	N/A	1469	1708
Cable 2 Z component	N/A	1713	1952

Hydrophone Parameters	
Detector type	Benthos AQ-1 / Sensor SQ-07
Group interval	25m
Detectors per group	7
Group length	9.0 m
No of groups per section	4
Hydrophones spacing	See diagram
Operating temperature range	-1 - +50 °C
Maximum operating depth	1000 m
Group sensitivity	8.4 V/bar ± 12%

Geophone Parameters	
Detector type	SM-4
Group interval	25m
Detectors per group	7
Group length	9.0 m
No of groups per section	4
Geophone spacing	See diagram
Operating temperature range	-1° - +50 °C
Maximum operating depth	1000 m
Group sensitivity	20.95 V/m.s^{-1} ± 5%
Natural Frequency	10 Hz ± 5%
Distortion (measured at 12Hz with 0.7 in/s pp coil to case movement)	< 0.2%


PXYZ-2 (Nessie 4C MultiWave Array)
Sensor Group Layout:
Group 9 to 12
Group 13 to 16
Group 1 to 4
Group 5 to 8
100 meter
25 meter
1.5 m
9 meter
P: Hydrophone
X: In-line geophone
Y: Cross-line geophone
Z: Vertical geophone





Courtesy of P. Maxwell, Sensor Nederland b.v.

12.2. Cable Plan

STBD CABLE Reel 2

	ASSI	CABLE	S/N	Son	USB	On	Dist.	Date	
		HSDJ-A							ANG_Reel-2
		HSJJ							ANG_Reel-2
		HSJAJ							ANG_Reel-2
		PXYZ-HB	9805 - Nr.1						ANG_Reel-2
		HSLWJ-C	???? - ??? - ???						ANG_Reel-2
		PXYZ-AB	9804-003-006F						ANG_Reel-2
		HSBJ	9804-002-002F						ANG_Reel-2
	B1		5186	**1**	**A12**		6100		ANG_Reel-2
1		PXYZ-2	9706-011-004F						ANG_Reel-2
	B2		5514	**2**			6000		ANG_Reel-2
2		PXYZ-2	9804-022-009F						ANG_Reel-2
	B3		5781	**3**			5900		ANG_Reel-2
3		PXYZ-2	0002-029-007F						ANG_Reel-2
	B4		5760	**4**			5800		ANG_Reel-2
4		PXYZ-2	0003-032-002F						ANG_Reel-2
	B5		5212	**5**			5700		ANG_Reel-2
5		PXYZ-2	9705-010-007F						ANG_Reel-2
	B6		5340	**6**			5600		ANG_Reel-2
6		PXYZ-2	9704-003-006F						ANG_Reel-2
	B7		5677	**7**			5500		ANG_Reel-2
7		PXYZ-2	9707-016-003F						ANG_Reel-2
	B8		5746	**8**			5400		ANG_Reel-2
8		PXYZ-2	9806-027-007F						ANG_Reel-2
	B9		5571	**9**			5300		ANG_Reel-2
9		PXYZ-2	9801-017-002F						ANG_Reel-2
	B10		5670	**10**			5200		ANG_Reel-2
10		PXYZ-2	0003-032-006F						ANG_Reel-2
	B11		5774	**11**	**A13**		5100		ANG_Reel-2
11		PXYZ-2	9803-019-006F						ANG_Reel-2
	B12		4877	**12**			5000		ANG_Reel-2
12		PXYZ-2	0202-034-005F						ANG_Reel-2
	B13		5502	**13**			4900		ANG_Reel-2
13		PXYZ-2	9805-025-005F						ANG_Reel-2
	B14		5691	**14**			4800		ANG_Reel-2
14		PXYZ-2	0202-034-009F						ANG_Reel-2
	B15		5413	**15**			4700		ANG_Reel-2
15		PXYZ-2	0203-037-002F						ANG_Reel-2
	B16		4805	**16**			4600		ANG_Reel-2
16		PXYZ-2	0202-029-010F						ANG_Reel-2
	B17		5531	**17**			4500		ANG_Reel-2
17		PXYZ-2	0202-034-010F						ANG_Reel-2
	B18		5460	**18**			4400		ANG_Reel-2
18		PXYZ-2	9704-005-010F						ANG_Reel-2
	B19		4064	**19**			4300		ANG_Reel-2
19		PXYZ-2	9803-019-002F						ANG_Reel-2
	B20		4567	**20**			4200		ANG_Reel-2
20		PXYZ-2	0002-029-008F						ANG_Reel-2
	B21		5749	**21**	**A14**		4100		ANG_Reel-2
21		PXYZ-2	0202-034-001F						ANG_Reel-2
	B22		5752	**22**			4000		ANG_Reel-2
22		PXYZ-2	9704-003-008F						ANG_Reel-2
	B23		5665	**23**			3900		ANG_Reel-2
23		PXYZ-2	0203-036-006F						ANG_Reel-2
	B24		5714	**24**			3800		ANG_Reel-2
24		PXYZ-2	0003-030-003F						ANG_Reel-2
	B25		5431	**25**			3700		ANG_Reel-2
25		PXYZ-2	0203-035-010F						ANG_Reel-2

	B26		5567	**26**			3600		ANG_Reel-2
26		PXYZ-2	9801-017-008F						ANG_Reel-2
	B27		5778	**27**			3500		ANG_Reel-2
27		PXYZ-2	0203-036-007F						ANG_Reel-2
	B28		5698	**28**			3400		ANG_Reel-2
28		PXYZ-2	0009-032-007F						ANG_Reel-2
	B29		5491	**29**			3300		ANG_Reel-2
29		PXYZ-2	9706-014-001F						ANG_Reel-2
	B30		5576	**30**			3200		ANG_Reel-2
30		PXYZ-2	0203-036-008F						ANG_Reel-2
	B31		5513	**31**	**A15**		3100		ANG_Reel-2
31		PXYZ-2	9802-018-003F						ANG_Reel-2
	B32		5551	**32**			3000		ANG_Reel-2
32		PXYZ-2	9806-028-001F						ANG_Reel-2
	B33		4043	**33**			2900		ANG_Reel-2
33		PXYZ-2	9704-002-007F						ANG_Reel-2
	B34		5334	**34**			2800		ANG_Reel-2
34		PXYZ-2	9705-009-008F						ANG_Reel-2
	B35		5552	**35**			2700		ANG_Reel-2
35		PXYZ-2	9705-007-010F						ANG_Reel-2
	B36		5411	**36**			2600		ANG_Reel-2
36		PXYZ-2	9804-023-005F						ANG_Reel-2
	B37		5368	**37**			2500		ANG_Reel-2
37		PXYZ-2	9707-016-008F						ANG_Reel-2
	B38		4114	**38**			2400		ANG_Reel-2
38		PXYZ-2	9706-014-003F						ANG_Reel-2
	B39		4576	**39**			2300		ANG_Reel-2
39		PXYZ-2	9802-018-009F						ANG_Reel-2
	B40		5235	**40**			2200		ANG_Reel-2
40		PXYZ-2	9705-006-007F						ANG_Reel-2
	B41		5357	**41**	**A16**		2100		ANG_Reel-2
41		PXYZ-2	9805-026-009F						ANG_Reel-2
	B42		4522	**42**			2000		ANG_Reel-2
42		PXYZ-2	9705-007-002F						ANG_Reel-2
	B43		5308	**43**			1900		ANG_Reel-2
43		PXYZ-2	9803-020-005F						ANG_Reel-2
	B44		5055	**44**			1800		ANG_Reel-2
44		PXYZ-2	9705-008-002F						ANG_Reel-2
	B45		4295	**45**			1700		ANG_Reel-2
45		PXYZ-2	9803-019-003F						ANG_Reel-2
	B46		5106	**46**			1600		ANG_Reel-2
46		PXYZ-2	9705-007-008F						ANG_Reel-2
	B47		4787	**47**			1500		ANG_Reel-2
47		PXYZ-2	9705-010-005F						ANG_Reel-2
	B48		4542	**48**			1400		ANG_Reel-2
48		PXYZ-2	9704-003-001F						ANG_Reel-2
	B49		5207	**49**			1300		ANG_Reel-2
49		PXYZ-2	9707-016-006F						ANG_Reel-2
	B50		5018	**50**			1200		ANG_Reel-2
50		PXYZ-2	9706-012-001F						ANG_Reel-2
	B51		5022	**51**	**A17**		1100		ANG_Reel-2
51		PXYZ-2	9804-021-010F						ANG_Reel-2
	B52		5135	**52**			1000		ANG_Reel-2
52		PXYZ-2	9704-003-010F						ANG_Reel-2
	B53		5286	**53**			900		ANG_Reel-2
53		PXYZ-2	9805-026-003F						ANG_Reel-2
	B54		5152	**54**			800		ANG_Reel-2
54		PXYZ-2	9706-013-009F						ANG_Reel-2
	B55		4093	**55**			700		ANG_Reel-2

55		PXYZ-2	9805-024-007F						ANG_Reel-2
	B56		4985	**56**	**A18**		600		ANG_Reel-2
56		PXYZ-2	9805-024-005F						ANG_Reel-2
	B57		5006	**57**			500		ANG_Reel-2
57		PXYZ-2	9806-027-004F						ANG_Reel-2
	B58		5273	**58**			400		ANG_Reel-2
58		PXYZ-2	9802-018-010F						ANG_Reel-2
	B59		5479	**59**			300		ANG_Reel-2
59		PXYZ-2	9804-023-009F						ANG_Reel-2
	B60		4692	**60**			200		ANG_Reel-2
60		PXYZ-2	9704-002-003F						ANG_Reel-2
	B61		5238	**61**			100		ANG_Reel-2
61		PXYZ-2	0003-031-008F	62					ANG_Reel-2
		PXYZ-WS	9804-002-001F						ANG_Reel-2
					A41				ANG_Reel-2

Configuration for cable 1 & 2 is identical.

13. Source Configuration

13.1. Source System Description

Source Parameters	
Number of source arrays	2
Array separation	50 m
Array length	15 m
Array width	12m
Number of strings/array	3
Separation from center track	25 m for
Source volume	2250 cubic inches
Number of hydrophones per array	6
Number of depth transducers per sub array	3 , 1 front, 1 mid , 1 aft
Number of guns per array	8
Number of clusters per array	6
Airgun type	Sleevegun
Operating pressure	2000 psi
Depth of guns	6 m
Peak to Peak amplitude	38,8 bar/m
Primary to Bubble ratio	12.6

13.2. Source Layout

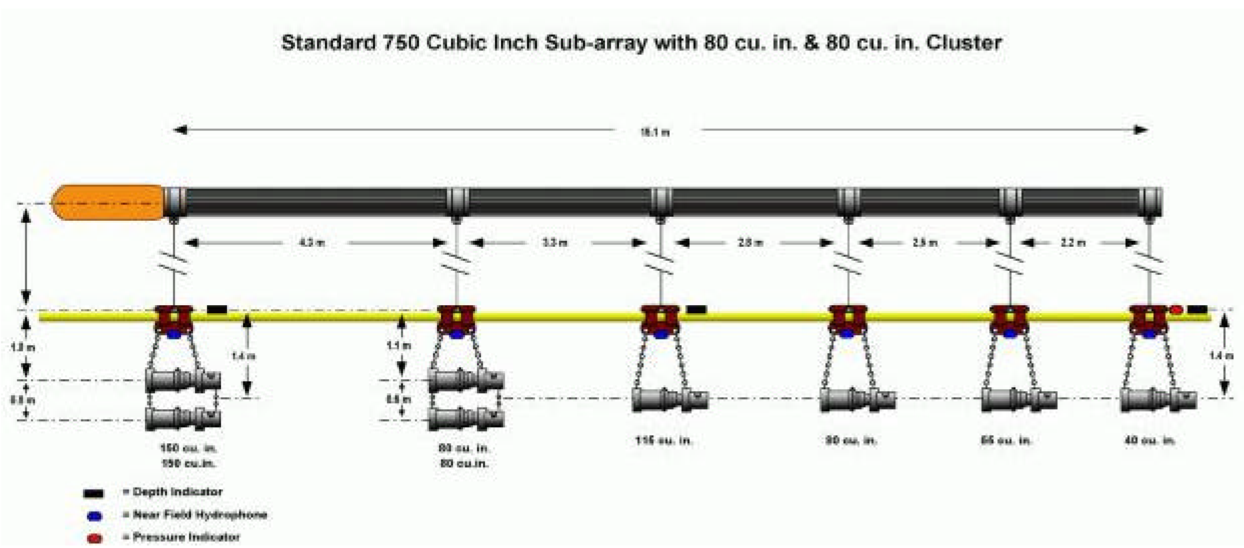
As indicated in the diagram, the sub-array comprises six tuning elements; two 2-gun clusters and four single guns. The clusters have their component guns arranged in an over/under fashion with the vertical distance between the gun ports set to maximize the bubble suppression effects of clustered guns. A near-field hydrophone is mounted 1.0 metre above each gun station (one phone is used per cluster), three depth transducers (fore, middle, and aft) are mounted on the gun hanging support member, and a high pressure transducer is mounted on the high pressure air supply manifold. All the data from theses sensors are transmitted to the vessel for input into the position systems and/or recording to tape.

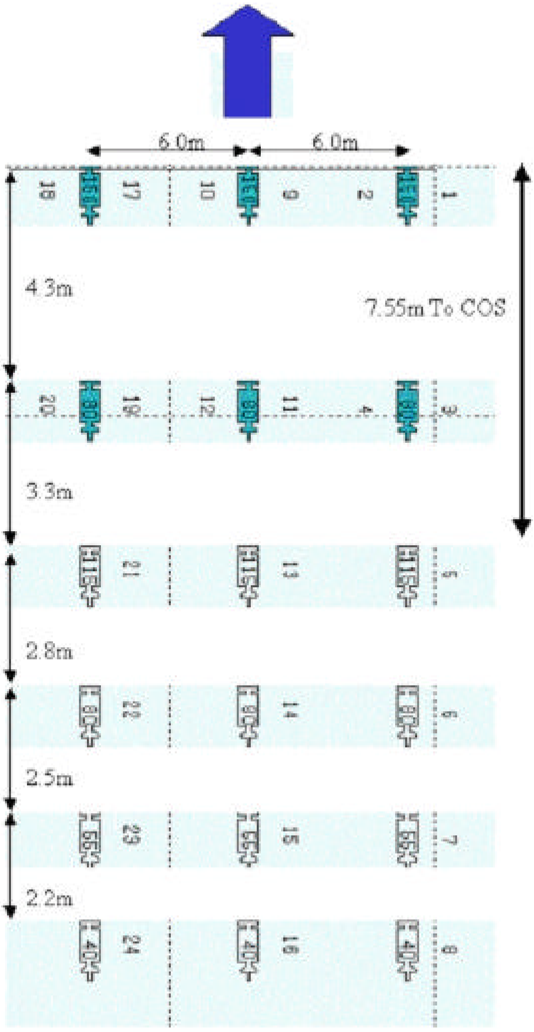
The standard configuration of a source array for 3D surveys consists of one or more 750 in^3 sub-array. When more than one sub-array is used the strings are lined up parallel to each other with a 6.0m crossline separation between them. This separation has been chosen so as to minimize the areal dimensions of the array in order to approximate point source radiation characteristics for frequencies in the nominal seismic processing band. For the 2250 in^3 array the overall dimensions of the array are 15 m long by 12 m wide.

The following diagram shows the array geometry. Positioning rGPS pods are located at the tail end of each sub-array.

2250 Cubic Inch Array Geometry

Note : Guns shown at head in Colour are clusters of 300 & 160 cubic inch (2 x 150 & 2 x 80)



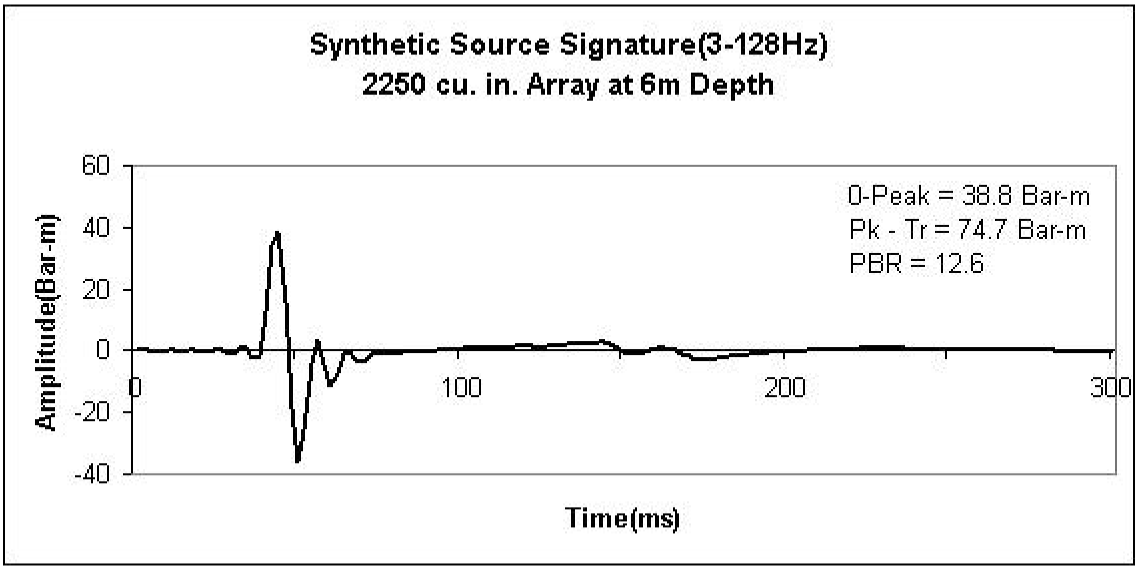


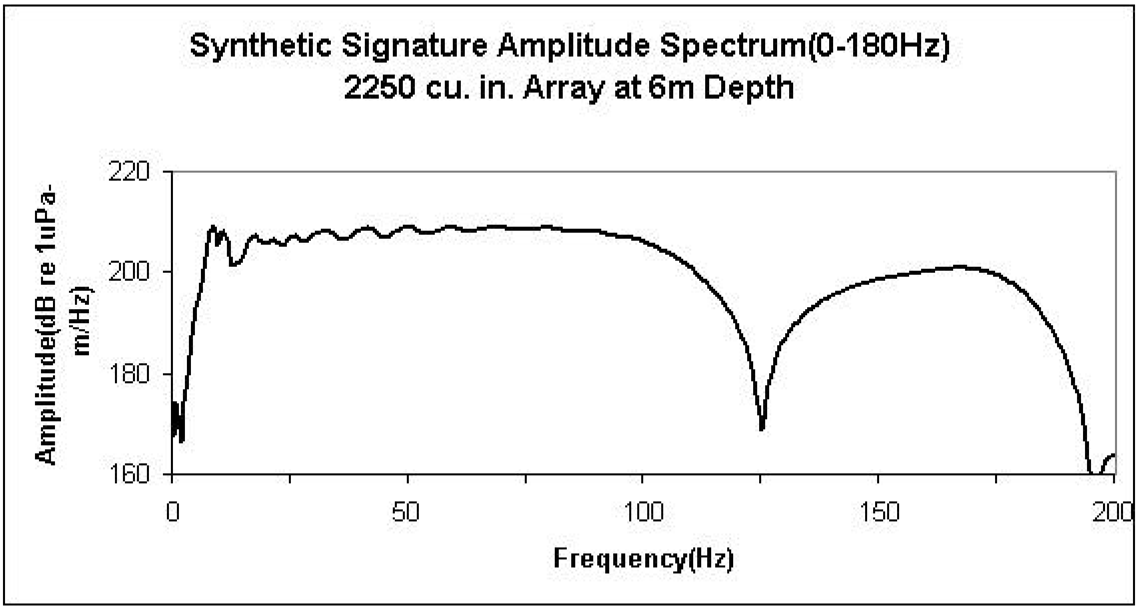
13.3. Pulse Response

2250in^3 Array Signature and Acoustic Radiation Patterns

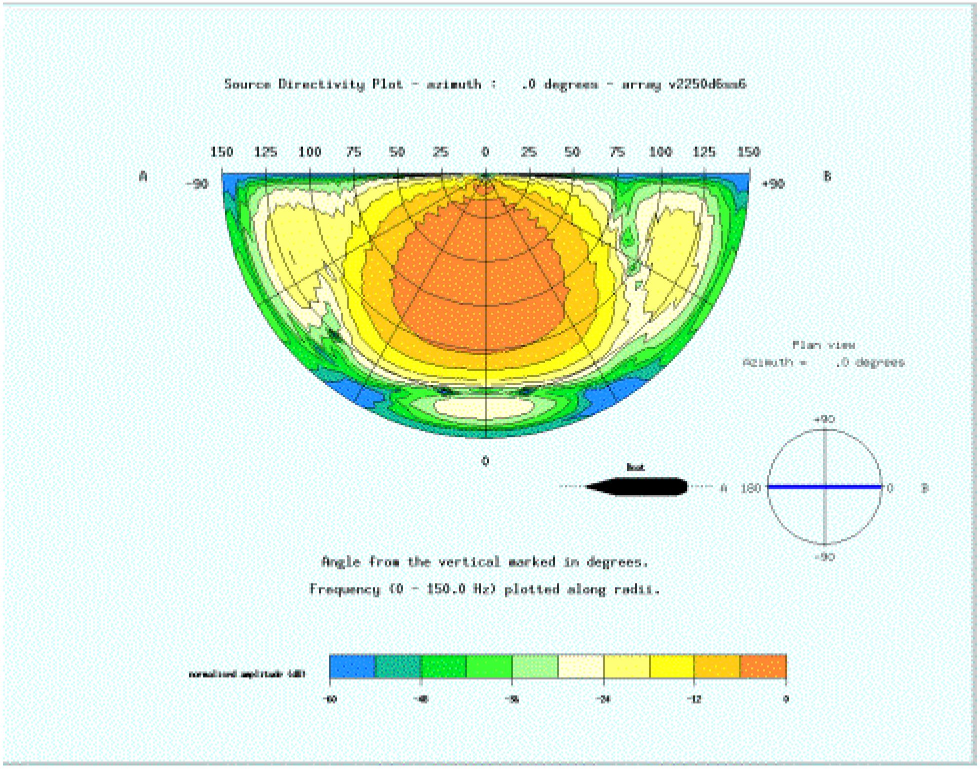
The following pages show the time series and amplitude spectrum for the far-field signature and the computed acoustic emission pattern for the vertical inline and crossline planes for the 2250 in^3 array with guns at a depth of 6.0 metres.

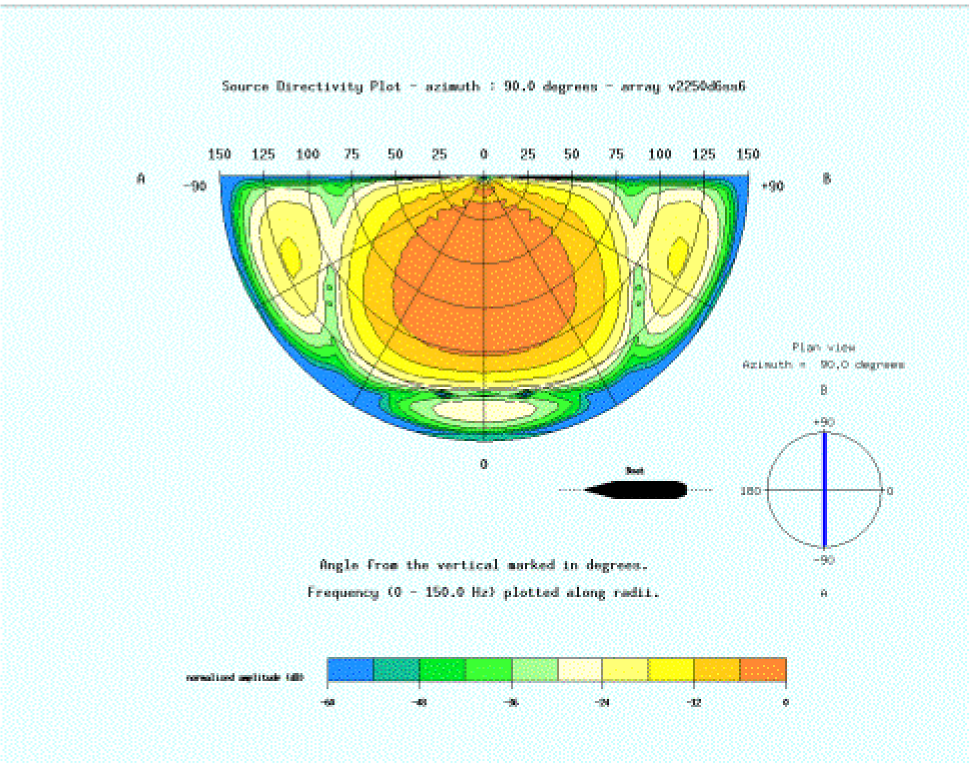
The signature for this array was computed using Western Geco's in house signature modelling software. The following table lists the gun parameters used as input to the model.



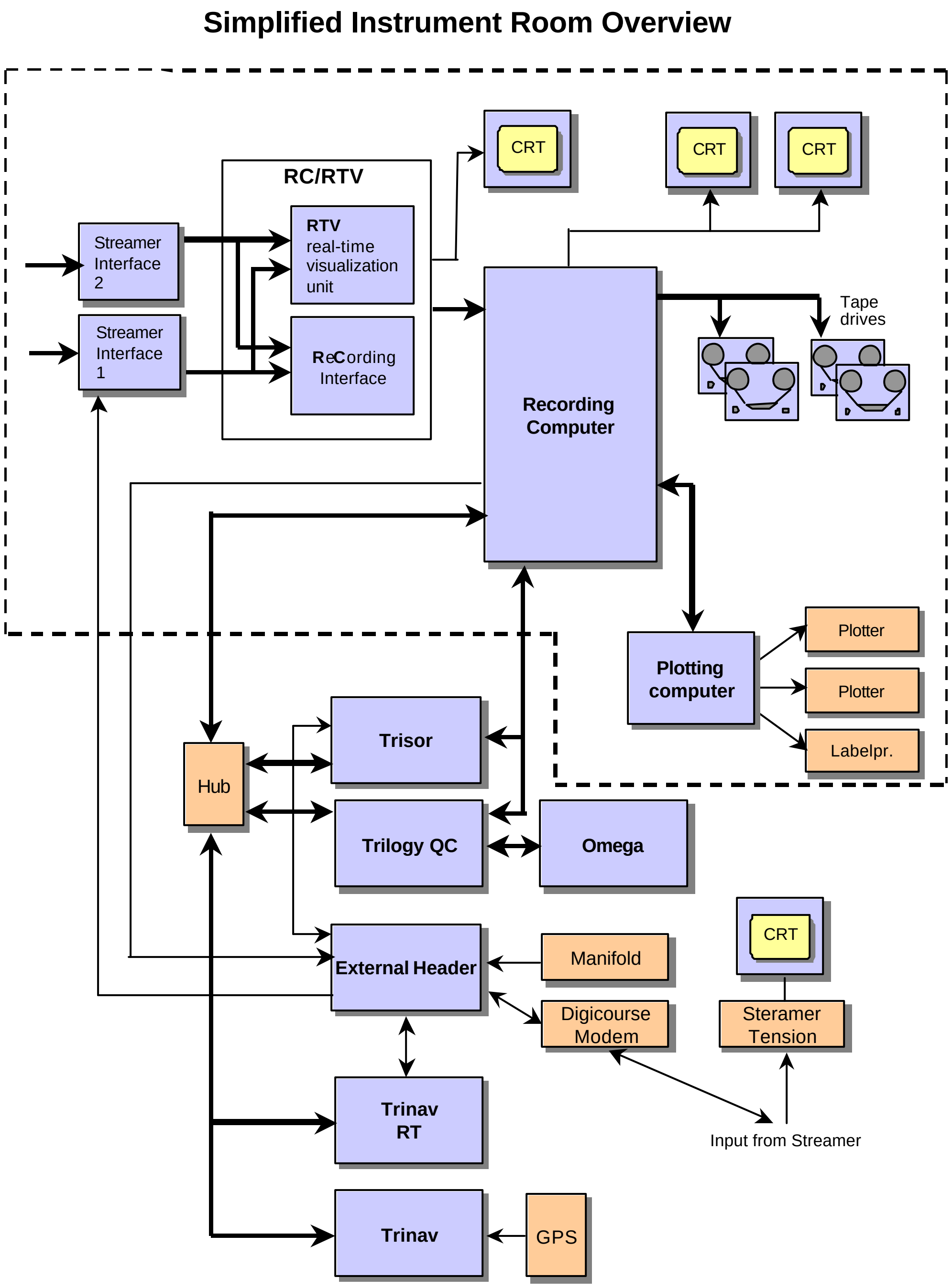


The acoustic emission pattern plots (for an array depth of 6.0m) show that the energy emitted by the array is uniformly distributed in the inline and crossline directions. This is a desirable feature for an array used to acquire 3D seismic data.


Source Directivity Plot - azimuth : .0 degrees - array v2250d6mm6
150 125 100 75 50 25 0 25 50 75 100 125 150
A
-90
+90
B
0
Plan view
Azimuth = .0 degrees
+90
180
0
-90
Boat
Angle from the vertical marked in degrees.
Frequency (0 - 150.0 Hz) plotted along radii.
normalized amplitude (dB)
-60
-48
-36
-24
-12
0


Source Directivity Plot - azimuth : 90.0 degrees - array v2250d6mm6
150 125 100 75 50 25 0 25 50 75 100 125 150
A
-90
+90
B
0
Plan view
Azimuth = 90.0 degrees
+90
180
0
-90
Boat
Angle from the vertical marked in degrees.
Frequency (0 - 150.0 Hz) plotted along radii.
normalized amplitude (dB)
-60
-48
-36
-24
-12
0

14. Instrumentation Room System Diagram



15. Equipment Offset Diagrams

ANTENNA AND SENSOR OFFSETS ANGLER

WesternGeco
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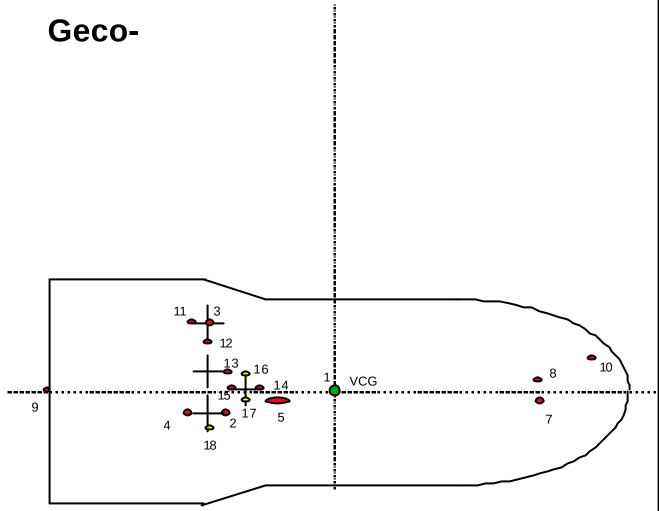
Solbraaveien 23
N-1370 Asker
Norway

POS	FRW	STB	MSL	SYSTEM
1	0,00	0,00	-0,16	Vessel Center of Gravity
2	-13,47	0,62	22,98	VTGPS (Trinav GPS)
3	-14,36	-2,38	23,05	VVERI A (Main ant.)
4	-14,62	0,61	22,96	Leica GPS (Bridge console GPS)
5	-8,80	0,71	-9,86	HIPAP USBL Tranceiver
6	-8,65	-0,70	-9,86	Hullpinger Sonardyne
7	28,04	0,15	-7,00	Echosounder 38 kHz
8	28,03	-0,14	-7,00	Echosounder 200 kHz , Not used
9	-32,25	0,00	0,00	Stern Roller
10	32,28	-4,1	14,26	Leica GPS, (RtCalib)
11	-14,75	2,41	23,05	VVERI B (Spare ant.)
12	-13,98	-2,02	23,05	Trimble Ant., Prev. MFIX Not used
13	-13,41	-0,95	22,95	Trimble Ant. Truetime Receiver
14	-11,17	0,05	23,51	Trimble Ant. Racal REDbox GPS
15	-12,67	0,04	23,49	Trimble Ant. Bridge GPS
16	-11,91	-0,54	23,51	Racal Spotbeam Ant.
17	-11,93	0,62	23,49	Bridge Fugro Spotbeam Ant.
18	-14,07	1,21	23,05	Fugro Spotbeam Ant. Not used

Remarks
The vertical reference point for the ECHOSOUNDER is the Tropical Fresh Water Load Line (TFWLL).

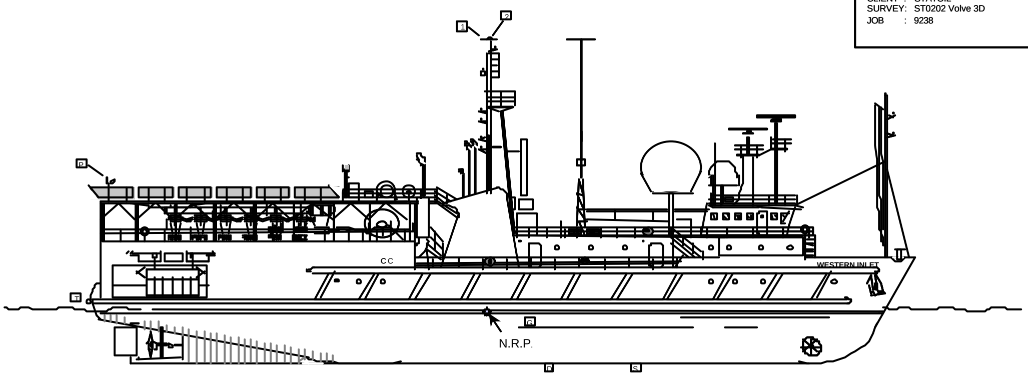
Not to scale



VESSEL	GECO ANGLER	From date	To date	From seq	To seq	
CLIENT	STATOIL	13.jun.02	16.July	001	161	Chief Nav: Peter Durran
AREA	Volve, Block 15/9, Offshore Norway.					
JOB no	9238					

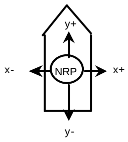
WESTERN INLET SENSOR OFFSETS

VESSEL : M/V WESTERN INLET
CLIENT : STATOIL
SURVEY: ST0202 Volve 3D
JOB : 9238



VESSEL LENGTH: 60.0 VESSEL WIDTH: 12.0 VESSEL DRAFT: 4.0

ALL MEASUREMENTS IN REFERENCE TO THE NAVIGATION REFERENCE POINT (X,Y,Z = 0)
NRP IS CO-LOCATED WITH ANTENNAE MAST ON CENTERLINE OF VESSEL AT WATER LINE.



	+FORE/-AFT	+STBD/ -PORT	+/- SEALEVEL
N.R.P. - NAV. REFERENCE POINT	0.00	0.00	0.00
1 - POSNET (WesternGeco)	0.00	0.00	21.32
2 - VERIPOS	0.00	0.00	21.32
S - SIMRAD ECHO SOUNDER	9.52	-2.00	-4.43
D - SONARDYNE TRANSDUCER	3.61	-0.87	-4.98
P - POSNET CALIBRATION TARGET	-27.92	0.11	10.16
T - TOW POINT	-28.55	0.18	0.03

Note: Vessel Offsets/Gyro surveys performed March 2001.

Drawing not to scale. All measurements in meters.

TOWING CONFIGURATION

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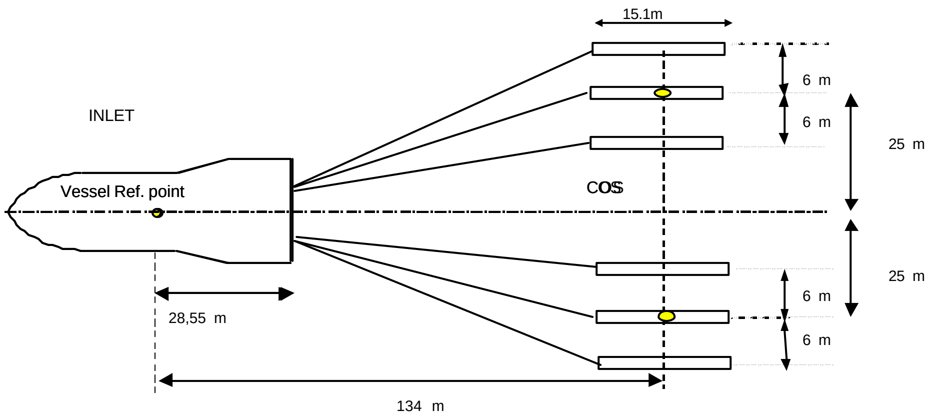

Not to scale

VESSEL	WESTERN INLET	From date	To date	From seq	To seq	Chief Nav: Peter Durran
CLIENT	STATOIL	########	16.July	001	161	
AREA	Volve, Block 15/9, Offshore Norway.					
JOB no	9238					

WesternGeco

GUN ARRAY OFFSETS

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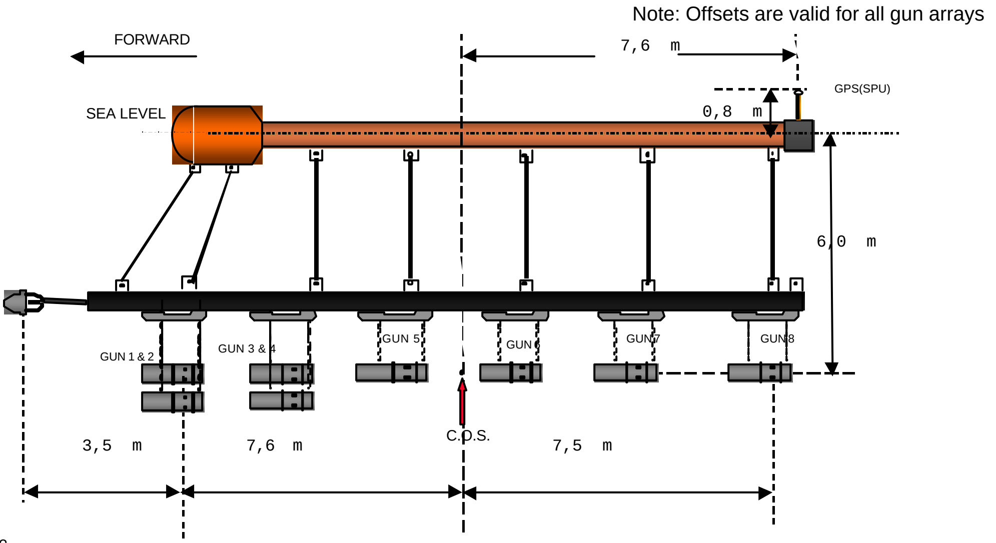
Norway



Not to scale

		From date	To date	From seq	To seq	
VESSEL	WESTERN INLET					Chief Nav Peter Durran
CLIENT	STATOIL	#######	16.July	001	161	
AREA	olve, Block 15/9, Offshore Norwa					
JOB no	9238					

WesternGeco

CABLE SECTION

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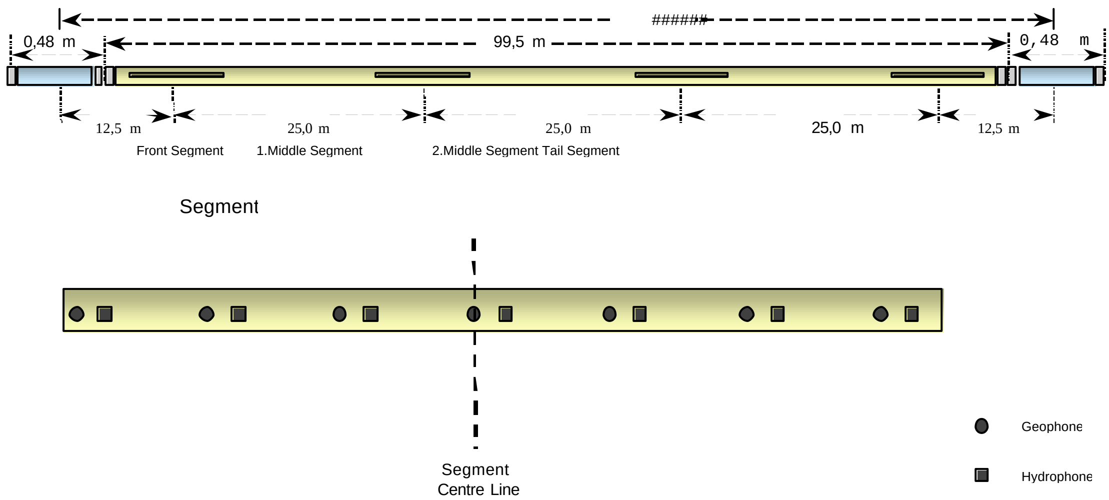
Norway



Not to scale

		From date	To date	From seq	To seq	
VESSEL	Geco Angler					Chief Nav: Peter Durran
CLIENT	STATOIL	########	16.July	001	161	
AREA	Volve, Block 15/9, Offshore Norway.					
JOB no	9238					

FRONT OF CABLE 1

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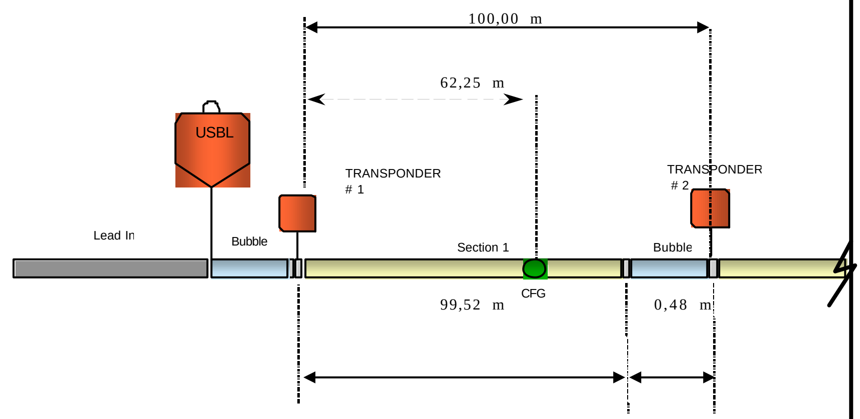
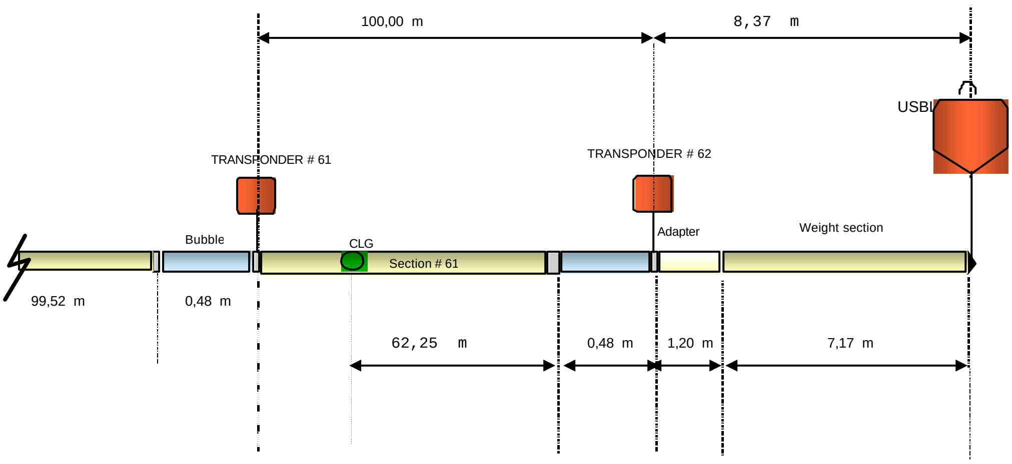


Not to scale

VESSEL	Geco Angler	From date	To date	From seq	To seq	Chief Nav: Peter Durran
CLIENT	STATOIL	#######	########	001	161	
AREA	Volve, Block 15/9, Offshore Norway.					
JOB no	9238					

END OF CABLE 1

WesternGeco
Schlumberger House
Solbraaveien 23
N-1370 Asker
Norway



Not to scale

VESSEL	Geco Angler	From date	To date	From seq	To seq	Chief Nav: Peter Durran
CLIENT	STATOIL	13.jun.02	16.July	001	161	
AREA	Volve, Block 15/9, Offshore Norway.					
JOB no	9238					

Navigation

16. Navigation and Positioning System Description

16.1. System Configuration

16.1.1. Navigation Hardware and Software

System	Hardware (Type and Serial No.)	Software version
TRINAV (Angler)	TRINAVRT	Trinav 2.6.0/Feb/2002/Patch19
Spectra (Inlet)	2 x ULTRA1,832F2CAE,832F2C49	7.6.06
External Header	EXTHDR	Version 8.0
Sonardyne (Inlet)	HP Vectra VL, FR73756685	GeniApps, V3.07
TS-meter (Angler)	Valeport 600 MK3, 17459 SIPPICAN MK12	
Echo sounder (Angler)	Simrad EA 500, 4129	
Echo sounder (Inlet)	Simrad EA 500, 1033	CP: 5.33, SP1 & SP2: 5.31
Current Meter(Angler)	RDI SEISADCP S/N 2767	Fugro GEOS SeisADCP V1.11

16.1.2. System Timing

TRINAV issued closures to the recording/source firing system 640 milliseconds before the predicted time of peak pressure. All TRINAV system positions are at the time of predicted peak pressure.

16.2. Survey Positioning Method Used

This 3D 4C multi-wave array survey was carried out using WesternGeco's mode of seabed cable operation for multi cable and dual source surveys.

Positioning of the vessel was by differential GPS, utilising TRINAV GPS ,WesternGeco Posnet, and OSIRIS VERIPOS, with delivery of differential correction data in RTCM SC104 format by WesternGeco Sargas, Thales Skyfix and Osiris Veripos.

Source positions were computed utilising Posnet rGPS. There were two sources towed by the M/V Western Inlet. Each source consists of three gun arrays. Each gun array carries a Source Positioning Unit (POD) placed in the string of the gun array. Positions from the POD units are then adjusted by Least Squares Adjustment to the COS.

The Sonardyne TZ/OBC system was used for cable positioning, as was the Sonardyne/Geniapps system. This was supplemented by QSolve 2.3, onboard the Angler, for an independent calculation of the Cal files for use in Trinav.

In the first phase the cable was laid by using approx 7 USBL transponders separated at 500/1000 meters or as required along the cable, providing additional way points for the bridge HIPAP operators to lay the cable onto the pre-plot position.

The second phase was the acquiring of the seismic data and navigating the source along the seismic line. This was performed as a normal seismic operation with the only difference being, that there was no streamer towed by the source vessel.
The Sonardyne transducer on the M/V Inlet ranged down to the transponders attached at 100m intervals along the cables, and by an estimation process, transponder positions were produced. These positions were used in re-processing to interpolate the positions of the receiver groups.

In addition First Break Pick data was logged together with the centre of source position. This provided cable positioning verification as well as a backup system.

16.3. Surface Positioning

16.3.1. Vessel Navigation

- **Geco Angler**

System 1:	TRINAV GPS	
	RTCM Delivery Systems :	Osiris Veripos
		Thales Skyfix
System 2:	Sercel NR203	
	RTCM Delivery Systems:	Osiris Veripos

- **Western Inlet**

System 1:	POSNET	
	RTCM Delivery Systems:	Osiris Veripos
		Thales Skyfix
		WesternGeco SARGAS
System 2:	Sercel NR203	
	RTCM Delivery Systems:	Osiris Veripos
System 3:	SOURCE POSITIONING	
	rGPS	WesternGeco Posnet

Primary vessel positioning was provided by TRINAV GPS.

TRINAV GPS is a multiple reference station DGPS system with the capability to be used in dual frequency mode when required, and tailored for the specific needs of seismic surveying. State-of-the-art algorithms combine reference station data and pseudo range measurements into the best position estimates.

By employing an exclusive correlation model for weighting the multiple range corrections in a least squares estimation process, the optimum pseudo-range corrections are obtained. W-testing and F-testing techniques detect and reject correction outliers.

Pseudo-range observations undergo comprehensive checks of validity and consistency before they are used in the fix algorithm. Carrier smoothing reduces the random noise effects on the pseudo ranges, and aids in multipath detection.

Integrity checking is a fundamental part of the processing philosophy: a Fault Detection, Isolation and Correction (FDIC) algorithm checks the consistency of the fix, detects and rejects any outliers, and re-computes the solution. W-testing and F-testing are used to give the best protection against erroneous observations.

Quality control is based upon UKOOA's recommended DGPS quality indicators - the precision and reliability of the fix are displayed as an Error Ellipse and Marginally Detectable Errors (MDE).

Secondary vessel positioning was provided by the third party multi-reference-positioning product, Veripos.

The two independent sources of corrections were transmitted to and received onboard the vessel by independent means thereby providing a high degree of redundancy to ensure continuous vessel positioning.

- **Further information about these systems is given in Navigation Exhibit 1.**

Although Selective Availability was turned off in May 2000 differential corrections are still required to provide a continuous high quality vessel position. Less frequent updates are required however.

16.3.2. Source Navigation

Source surface navigation was provided by PosNet. The in-sea units incorporated a GPS receiver and interfacing for direct data transmission of the raw satellite pseudo-range data through the source cabling.

On board the vessel, the raw pseudo-range data from the float unit was matched with simultaneously received data at the vessel's GPS receiver to compute a vector describing the location of the float unit relative to the vessel from which the float position was derived. Relative positioning was better than 2m.

16.4. Cable Positioning

16.4.1. TZ/OBC Acoustics

- **<u>Positioning Procedure</u>**

The cable positioning was performed using the Sonardyne TZ/OBC acoustic positioning system. The system consists of 62 transponders, attached at a distance of every 100m to the cable, a hull mounted OBC12 transducer on the source vessel and a personal computer, installed on the source vessel.

The positioning was carried out by collecting range data from the transducer to the cable mounted transponders. Ranges from both sides of the receiver line were collected. A distance to the receiver line of approx. the water depth was kept, to maintain the angle of cut close to 90 degrees.

The central computer placed on the source vessel controlled the necessary commands to the transponders and all computations.

The Sonardyne Genieapp Software Version in use was: 3.07

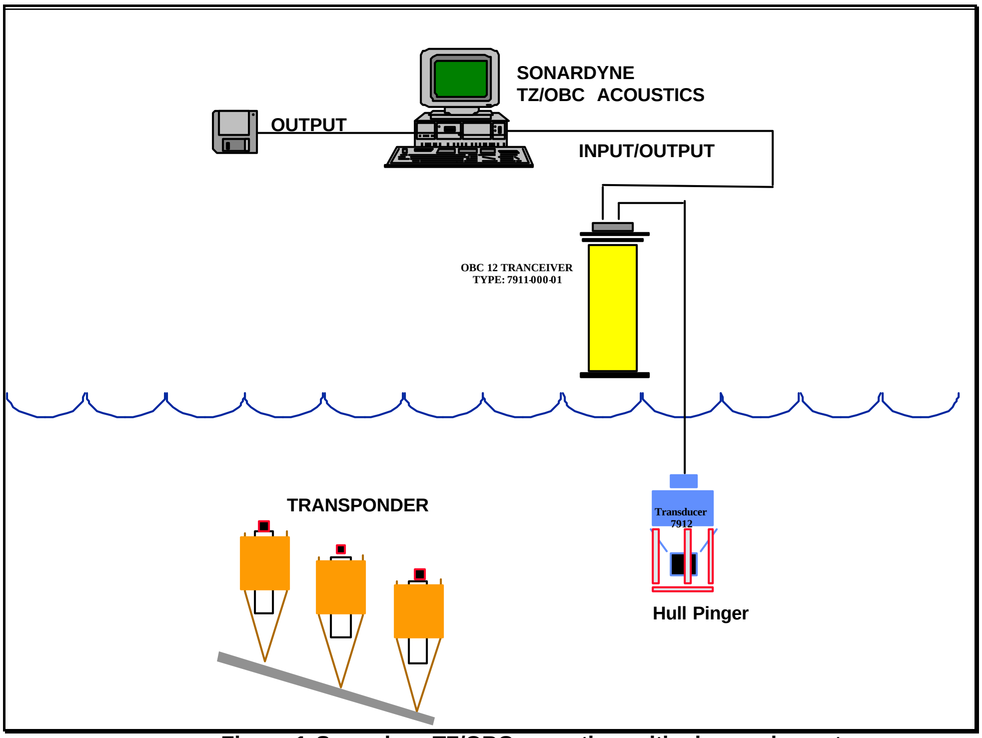


Figure 1. Sonardyne TZ/OBC acoustic positioning equipment

- <u>**System Accuracy**</u>

To determine the range measurement accuracy of the system, a trial was carried out at Sonardyne's research base in Plymouth, UK.

A large rigid test frame was manufactured to separate the acoustic transceiver and the transponder by a known fixed distance. The distance between the centre of the transceiver's transducer and the centre of the transponders transducer was accurately measured with a tape measure.

The frame was then deployed in the water at a known depth and the speed of sound constant at the frame depth measured. The system was then set to continuously range between the transceiver and the transponder and collect the raw millisecond timing data. Approximately 400 samples were collected and the data analysed.

Long ranges caused by local reverberation of the acoustic signals were removed and a histogram of the range data produced. The timing repeatability of the system to one sigma standard deviation was found to be 0.0376m with 412 samples.

The same process was carried out over a number of different baselines and the calculated range compared with the real range. The range offset between the measured range and the real range was found to be constant over distance. This offset calculated was subtracted from the measured range before being used to determine the position of the transponders.

To allow reverberation from the interrogation pulse to die down, the transponder incorporates a known delay called the Turn Around Time (TAT). The timing accuracy of each transponders validation cycle and TAT is checked as part of production testing.

- **<u>Position Computation</u>**

The system requires input of several different parameters. Among these were sound velocity, calibration constants and pre-plot co-ordinates.

The pre-plot co-ordinates of the transponder positions have to be input into the system. These co-ordinates should have an accuracy of approximately 50m and are used as starting co-ordinates for the sequential least squares estimation which lead to the final transponder co-ordinates.

The update rate is different for the surface and sub-surface parts of the system. The TRINAV system position output is at a rate of once per second. The update rate of the acoustic system is dependent on the range gate setting and the setting of the interrogation interval in the ADIF file. The range gate setting enables the system to interrogate a transponder when it will come into a certain range. GPS time was used for common time reference. All records were time stamped at the time they were received by the system.

All raw data was collected and stored in an ASCII file (*.CLI) by the Sonardyne TZ/OBC system. This file was transferred to the Geco Angler over the link, and then the file was processed using QSolve software which is used to process the acoustic data and to compute the final transponder positions using least squares adjustment. The system outputs a variety of quality figures, which can be displayed using the graphical interface. The operator has also the option to reject individual observations or individual nodes to improve the solution. These final files (*.CAL) files were then input into Trinav, where plots and position checks, made up the final QC of the cable positions. These cable positions were then the final product and the ones used for the future Source runs of the survey.

16.4.2. USBL Acoustics

For deployment of the cable, the Simrad HIPAP USBL acoustic positioning system on the Geco Angler was used. USBL transponders were attached to the cable at distances of approx. 1000 meters along the cable. Additional transponders were deployed at the tail of the cable to aid initial deployment and dragging. During deployment, the cable was laid or dragged into position, by using the transponder positions as reference.

16.4.3. First Break Picking System

On the Geco Angler, QSolve Software was installed on Navpr1 work station, a Unix Platform, as part of the Trinav system. Although the primary purpose of QSolve was to process the raw (*.cli) files, from Sonardyne, it did also have the ability to process First Break Picking using Seg Y data from OBP. This was onboard as a backup only, in case of problems with Sonardyne, and as such was not needed while Sonardyne was working fine, which it did for the whole survey.

16.4.4. Gyro Compass

- **Geco Angler**

The gyrocompasses used during the survey were:

Instrument Room Gyro - Gyro 1 SGBrown Serial No 876
Ships Gyro - Gyro 2/1 Robertson RGC12, S/N 2170
Ships Gyro - Gyro 2/2 Robertson RGC12, S/N 1831.

The gyro correction values as computed from the last gyro calibration, and from Offshore Calibration techniques employed during the last surveys are as follows..

Instrument Room Gyro - minus 1.00°
Ships Gyro - minus 0.48°

- **Western Inlet**

The gyrocompasses used during the survey were:

Ships gyro 1 - Sperry MK 37VT S/N 5709
Ships gyro 2 - Sperry MK227 S/N 13R

The gyro correction values as computed during the last dockside calibration carried out by Racal NCS, Inc. while the vessel was in dry dock at the First Wave East Terminal on Pelican Island, Texas, March 27th –28,th 2001 are as follows:

Ships gyro 1 - plus 1.22°
Ships gyro 2 - minus 0.41°

16.4.5. Velocity of Sound in Water

The following type of TS-meters were available on the Geco Angler for determining the speed of sound through the water, and a water column

- **Type: Valeport Series 600 MKII**

Valeport Series 600 MKII is a direct Reading Meter temperature / salinity probe which outputs measurements of depth/pressure, salinity/conductivity and temperature to a control display unit. Measurements are manually recorded when the probe is deployed at each depth. The user computes the speed of sound from the readings taken.

- **Type: Mk12 Ocean Data Acquisition System (Sippican Probe)..**

Mk12 Ocean Data Acquisition System (Sippican Probe) is disposable. The velocity is used for deep water velocity profiles for depth reduction (2000m). The probe is a profiler allowed to free-fall and is not recovered; data is transmitted back via a thin copper wire and an interface card fitted to a PC. The PC computes speed of sound.

16.4.6. Echo Sounder

The Western Inlet echo sounder speed of sound was set to 1500 m/s. No draught correction was entered in the echo sounder. The speed of sound for the total water column was derived on the prospect area using Sippican Probe, (in most circumstances) as described above.

16.5. Auxiliary Navigation Sensors.

16.5.1. Current Meter.

Data from an Acoustic Doppler Current Profiler, or Current Meter, was not used for this survey.

16.5.2. Gravity.

Gravity acquisition was not a requirement for this survey.

17. Navigation Systems Verification and Monitoring

17.1. Echo Sounder Verification

- **Geco Angler**

As we will be using the Inlets echo sounder during this survey, no calibration was performed. However, a gross error check, using a lead line, was carried out on 30th Jan 2002, while vessel was alongside in Surabaja, Indonesia. This has been included as the last check that was done on the Angler Echo Sounder.

> **The calibration results are in Navigation Exhibit 2**

- **Western Inlet**

No calibration was performed. However, a gross error check, using a lead line, was carried out on 30th April 2002 while the Western Inlet was alongside in Ulsteinvik.

> **The calibration results are in Navigation Exhibit 2**

17.2. Gyro Monitoring

- **Western Inlet**

Continuous monitoring of the vessel gyros was performed using TRINAV's rtCalib utility program and a GPS baseline.

The gyro correction estimates provided by this program have been monitored and compared with previous dockside verification values and previous surveys.

> **The gyro verification results are in Navigation Exhibit 3**

17.3. GPS Monitoring

Continuous monitoring using the Integrity Monitor was carried out offshore to verify that the installations were satisfactorily operational (data reception, transmission, processing and logging were verified) and that the operational settings were correct**.** Each system to be used, including duplicates, was verified.

> **The TRINAV GPS Integrity Monitor station in use is described in Exhibit 1.**

17.4. USBL Calibration

The system is calibrated offshore prior to use. The calibration consists of finding C-O values for x, y and z offsets, scale and x, y and z rotations. Prior to offshore use the x and y offsets and the scale is calibrated to be set to zero. Z offset relates to the depth and is checked versus the vessel's echo sounder. X and y rotations are about the pitch and roll axes of the vessel. The z rotation is about the yaw axis, i.e. the heading error of the installation. All connected sub-systems must be individually calibrated before use with the system.

The calibration is performed by using a transponder on the seabed and recording data in all four quadrants before performing a least square estimation on the data to get the C-O values.

- **The results of the USBL calibration are given in Exhibit 4**

18. Navigation Processing

18.1 The TRINAV System

TRINAV consists of a network of SUN SPARC workstations, external mass-data storage and hard-copy facilities running WesternGeco proprietary software on the UNIX operating system. Positioning sensors are interfaced to TRINAV through two VME sub systems.

The positions for each vessel/float are passed through a Kalman filter, where they may be integrated with speed and heading inputs. The output of the primary vessel Kalman filter is used for predicting the time when the first CMP position will be at the required distance along the preplot line. Relays are closed a fixed time prior to the estimated time of peak pressure. The raw, decoded data strings, and computed positions are stored to disk/tape.

The raw sensor data and Kalman filtered surface positions are passed from the Real Time acquisition system (TRINAV RT) to a near real time source and receiver positioning system (TRINAV QCPR). TRINAV QCPR computes positions online and provides facilities for any post processing required.

The data received by QCPR is immediately stored in a Techra relational database with directories for raw, filtered and processed data. Front, middle and tail networks are solved by least square adjustment at every shot-point. In-sea measurements are ‘clipped’ to remove large spikes. Statistical models are used to test the results of the adjustment, by detection of outliers. If the first iteration fails then the adjustment is repeated after the largest outlier has been removed. This routine is repeated until a satisfactory adjustment is achieved.

The quality of the data is then evaluated with the TRINAV application Diagnostics, against a set of standard criteria. WesternGeco's PAC, or **P**osition **A**cceptance **C**riteria, comprises a set of tolerances on specified statistics, which allow this objective assessment of the positioning quality to be made.

The resulting node positions are then smoothed using Kalman filters. From the source node, the centre of source position is computed. The streamer cable shapes are computed from filtered compass data in order to establish positions for all the receiver groups. Wherever possible, the results of the real-time source and receiver positioning were used to make the final positioning data set. When the results from the online solution exceed the PAC additional processing was carried out on the ‘off-line’ system.

Final and raw navigation data in UKOOA standard formats was generated directly from the database on the off-line system. Available media are 3480 cartridges, 3590 cartridges and 8mm Exabyte cartridges.

The technique for these is described in **WesternGeco's Navigation systems – a Technical Introduction,** which is available upon demand.

18.1.1 Shot Editor

The Shot Editor was available for use on all lines as follows:

- Editing of non-production shot-points at the start and end of each line.
- Interpolation of missing shot-points.

18.1.2 Gun Editor

The Gun Editor was available for use on all lines as follows:

- The Gun Editor was used on shot-points interpolated by the Shot Editor to generate the missing gun mask. The gun mask is normally relayed to TRINAV via the External Header.
- The Gun Editor was used to change the status of the sources to non-firing for any NTBP sections of the lines.

18.1.3 Recompute

The vessel system position was computed and the positions saved at one second intervals to disk/tape by TRINAV RT. The positions of all objects at the predicted time of peak pressure were passed to TRINAV QCPR and stored in the database online.

Diagnostics was used on each line to decide if the real time Kalman filtered positions were acceptable. If the positions were not acceptable, the Recompute program was used to select different positions for each object or to merge different DGPS systems for parts of the line.

If new positions were selected in the Recompute these were Kalman filtered in the Smoother program using a forward backward Kalman filter.

The following plots were available for examination and comparison of the positioning systems:

- User selected track plot display of color-coded positions.
- Inline and Crossline time series shot to shot plots for selected positions.
- Inline and Crossline time series difference plot between selected positions and a reference position.
- Time series plots giving stochastic analysis of position quality for selected positions.

18.1.4 Smoother

The Smoother program is used for smoothing of surface positions offline and for smoothing of tracking nodes both online and offline.

When QCPR is acquiring data online the tracking node positions are smoothed using a forward Kalman filter. If the tracking node positions exceeded the PAC tolerances, they were re-smoothed offline using a Forward-Backward Kalman Filter. If new positions were selected in the Recompute program these were smoothed and time adjusted to shot time using the Kalman Forward-Backward filter.

- **<u>Kalman filter</u>**

This filter assumes that between any two shot points there will be zero average acceleration but some oscillation (noise) around the average.

- **<u>Forward-Backward (FB) Kalman Filter</u>**

All smoothing in post processing was performed using a Forward-Backward Kalman filter. This is essentially the weighted average of the raw data and two individual Kalman filters running in opposite directions through the data set.

This filter has the same acceleration parameters as the online Kalman filter but has separate rejection window parameters (for X and Y) thus enabling the user to model the expected motions independently. The FB Kalman filter for surface positions works in the area relative co-ordinate frame, while the FB Kalman and Kalman filters applied to the tracking nodes work in a vessel relative coordinate frame.

The quality of the smoothing was checked using the following difference plots:

- Difference between smoothed and un-smoothed data was checked to see the effect of the filter settings applied.
- Velocity cross-line and in-line plots indicate the amount of noise in the smoothed position.
- Variance Factor plot indicates the fit between the predicted and raw positions.

18.1.5 Filtering

- **<u>Gyro Filtering</u>**
  - Filtered to de-spike and interpolate missing data if necessary

18.1.6 Reprocessing

The source position computation is divided into two steps. These steps are executed automatically online. If post processing is required the operator is able to change parameters and examine the output between steps.

The processes are:

1. Least Squares solution of the network.
2. Kalman/Kalman FB smoothing of network tracking nodes

The least squares solutions include statistical testing and automatic rejection of outliers on a shot by shot basis.

18.1.7 Processing of Cable Positions in TRINAV

- **<u>Sonardyne TZ/OBC</u>**

Transponder positions were computed by the Sonardyne TZ/OBC software and then imported to the TRINAV database from a *.CAL file using the program ReceiverPos.

The Sonardyne transponder positions are read and matched with the Sonardyne sensors on the cable defined in the survey definition. A spline algorithm is used to calculate the receiver positions. This algorithm is also able to extrapolate in case of missing transponder data at front or tail end of the cable. These final receiver positions are written to the offline database and used for binning and final deliverables.

No tools are available in TRINAV to manipulate or smooth the receiver lines, but it is possible to view the source and receiver positions using Lineplot. The differences between the final and pre-plotted source and receiver positions can be displayed graphical and numerical.

- **USBL**

This method was not utilised on this job.

An estimator is made for each USBL float. This takes the following as input:

- usbl_shift parameters, which are defined in the survey definition
- X,Y and Z measures from the USBL system
- Primary vessel estimator
- Gyro
-
- These measures are used to calculate the position of the USBL sensor and this is then fed into the kalman filter of the estimator. An amount of more than 100 estimator positions were calculated for each transponder online and stored in the TRINAV database.
-

Fault detection Isolation & Correction (FDIC) algorithms are run on the computed estimator positions and a final position computed for each USBL. The number of accepted and rejected ranges can be viewed. Also, any beacons indicating a bad status on their string will be rejected.

-

Offline the USBL transponder positions are read and matched with the USBL sensors on the cable defined in the survey definition. The final computed USBL positions can then be compared for C-O radial distances. If a C-O for a USBL position exceeded the limit of 7m, the USBL unit was set passive in the insea survey definition, and the USBL data were imported again. The average position of each active transponder was used in a spline algorithm to calculate the receiver positions. This algorithm is also able to extrapolate in case of missing transponder data at front or tail end of the cable. These final receiver positions are written to the offline database and used for binning and final deliverables.

No tools are available in TRINAV to manipulate or smooth the receiver lines, but it is possible to view the source and receiver positions using Lineplot. The differences between the final and pre-plotted source and receiver positions can be displayed graphical and numerical.

- **First Break Picking**

This method was available, but was not needed on this survey…

The final receiver positions are computed within the QSolve software from the raw data supplied by Sonardynes Geniapps, and imported into TRINAV from an SPS file.
It is possible to view the source and receiver positions using Lineplot. The differences between the final and pre-plotted source and receiver positions can be displayed graphical and numerical.

18.2 Quality Control

Navigation post-processing was carried out on-board through to SPS and P2/94, tape production, as well as a requirement for P1/90 Vessel/Source positions.

18.2.1 First Line Test Data

After the first line was shot and processed, a test line was sent electronically to an external contractor, ECL. The data sent comprised:

1. All offset diagrams (vessel, cable, source)
2. Offset spreadsheets
3. Geometry drawing
4. Observer's channel allocation spreadsheet
5. Velocity Profile Spreadsheet
6. 100 shot points of SPS and P2 data
7. SPS Check Sheet
8. ASCII file of Diagnostics for the source line
9. ASCII file of LAF for this line
10. ASCII files of Surface and Insea Survey Definitions
11. Job Book (as supplied from the supporting office)
12. Minutes from Start-up meeting (if relevant)
13. P1/90 File containing preplots
14. Report file produced from the binning program

A thorough QC of this test line was undertaken. The following checks were carried out:

- Strict compliance with published UKOOA P2 header and data format and generation of Format Check Reports.
- Graphical display of source and receiver geometry and comparison with WesternGeco office and vessel generated diagrams/documentation.
- Full vessel Configuration Report, as defined in the P2 header.
- Check P2 header defined Tow Points, Geodetic Parameters, etc. against WesternGeco Job Book and/or published values.
- List P2 header differences from a prior line sequence (if required).
- Raw data display and analysis
- Automated and manual (if required) data conditioning.
- Data processing to independently resolve vessel, source and receiver co-ordinates.
- Investigation of unacceptable positioning data quality.
- Data check and Statistics Report for compliance testing with survey contractual standards and specifications.
- Check of binning parameters in the vessel-supplied report file against the WesternGeco Seismic Work Order.
- Check of preplot waypoints and geodetic parameters in P2 against P1/90 preplot file.
- Generation of statistics, error reports, test results, displays etc. as deemed necessary to highlight problem areas.
- Check P2 header, Insea survey definition and Surface survey definition parameters and data complies with WesternGeco standard definitions.
- Other survey start-up tests and checks as required and directed by WesternGeco.
- Check the SPS format source, receiver and relation files for format and data errors using the SPS Checker software.

When all the checks were performed a feedback report was published on ECL's secure web site. Any corrections required were made by the vessel. The Supporting Office and ECL then received a confirmation from the vessel that all updates had been completed.

18.2.2 Initial QC

- **Source Line**

  - The post-processing procedures included the following checks:
  - QC checks on all survey parameters.
  - Generation of correct survey definitions.
  - Completion of shot point edits.
  - P2/94 production.
  - Completion of gun edits.
  - QC of system position and recomputes if required.
  - Smoothing of the vessel and float positions if required.
  - Selective check and filtering if required, of the observations including:
  - Gyro heading.
  - Least squares adjustment of front network if required.
  - Smoothing of source tracking nodes if required.
  - Processing final source positions.
  - Comparison of final source positions against preplots.
  - Creating relation data to link the source line to the correct receiver line(s).
  - Final QC of all lines.
  - SPS production.

- **Receiver Line**

  - QC checks on all survey parameters.
  - Generation of correct survey definitions.
  - QC of the computation of receiver positions, reprocess if required.
  - Comparison of final receiver positions against preplots.
  - Final QC of all lines.
  - SPS production.

A final QC was performed by the onboard processing group when the seismic data were merged with the SPS navigation data. A LMO plot was created for each line, which displayed the match of the seismic data with the delivered source and receiver positions.

The following documentation was produced for onboard QC:

- Navigation reports detailing information about the survey parameters, calibrations and continuing daily logs.
- A series of statistics and plots from on-line data acquisition:
- Navigation line logs detailing performance and parameters used for the surface positioning, acoustics and compasses for each line.
- Seismic observer's logs detailing gun information.
- Edits list from the seismic observers detailing gun information.

18.2.3 Final QC

The post network solution QC plots and statistical printouts detailed in the previous section were examined and compared to WesternGeco specifications. In addition, trend analysis plots were created and analyzed every 20 lines to ensure consistency throughout the data set.

18.3 Water Depth Processing

Water depth processing was done on the raw water depth data onboard the vessel.

The raw water depth had the following corrections applied:

- corrected for draught
- corrected for tide.
- filtered to de-spike and interpolate missing data
- corrected for measured sound velocity in water

The final data are a part of the SPS file format and was dispatched on 3590 tape direct from the vessel.

19 Observations

19.1 Navigation Summary

All systems performed well, however during acquisition the below systems required further detail.

-

19.1.1 TRINAV GPS Integrity Monitor

The Asker Integrity Monitor was used throughout the survey, and results look quite good..

19.1.2 rGPS (Floats)

Overall POSNET source positioning system worked okay. This survey ran a lot more smoothly than the last, which will be the result of 2boat antenna modification, which meant we didn't get the hang-ups from POSNET on the link, as we saw before on the last survey.

19.1.3 TZ/OBC Acoustics

The positioning of the cable during this survey has been very good, with no delays recorded. Clients were quite happy with the cable positioning on all swaths.

19.1.4 USBL Acoustics

The HiPaP system performed well as usual, however several transponders had to be replaced due to malfunction. A failing rate of 3-5 units per month is treated as normal. This has been observed during other surveys as well. This is associated with the rough environment the units are exposed to.

19.1.5 First Break Picking System

The FBP software, namely QSolve, is installed on the Trinav system, as a backup only, and will be used in the event that we cannot use Sonardyne for positioning the cables. For this survey, we were able to use the Sonardyne throughout and so FBP was not used.

19.1.6 Gyro

Two gyros were present on the source vessel. The MK37VT was used as the master gyro for this survey, all gyro data passed to Angler was from said MK37VT. No gyro problems were encountered during acquisition.

19.1.7 Echo Sounder

The Inlet echo sounder data was observed to be noisy in poor weather – associated with the movement of the vessel, in high seas. At other times, it performed very well.

19.2 Processing and QC Summary

All receiver and source positioning was achieved within specification and final positioning was confirmed by LMO plots.

Source sub array separations were monitored and assessed on a line-by-line basis. The geometry remained static throughout the survey as can be seen by the Trend Analysis charts.

On Swath 1, 4 and 6, we were getting link dropouts at one end of the survey. During a lull in activities, because of time sharing, the link antenna was raised another 3 mtrs, and we finished the swath without any further link dropouts in the survey area. We had been able to move the dropout area to outside the survey area, commencing at around -1200 until -800, on the run in. After that the link would be great for the whole line. The structure that was put up at sea, was pulled down and strengthened while alongside in Stavanger, a few days later. We finished the survey with this modification.

19.3 Conclusions

No major problems were encountered during the survey.

We were hindered by time sharing between ourselves, the Altantic Explorer and the Veritas Vantage. However all three units co-operated pretty well during the survey, the Atlantic Explorer finishing her area half way through our survey, which then just left ourselves and the Veritas Vantage, which was shooting long 5.5 hour lines, and letting us shoot 3 lines during her line changes. Just about when the Diamond was due to arrive in the survey area, we had a platform turn up and needed positioning. This put us out of action for a couple of days, while the assisting vessels deployed her cable pattern. When we did get back into production, we were again in a 3-way time sharing situation, with the Vantage and the Diamond, and this was how we finished the survey.

Weather didn’t play a major part, as was expected with 4C. We did get held up a little in Swath6 due to Inlet not being able to deploy the guns, as it was too rough, but this was only a small delay.

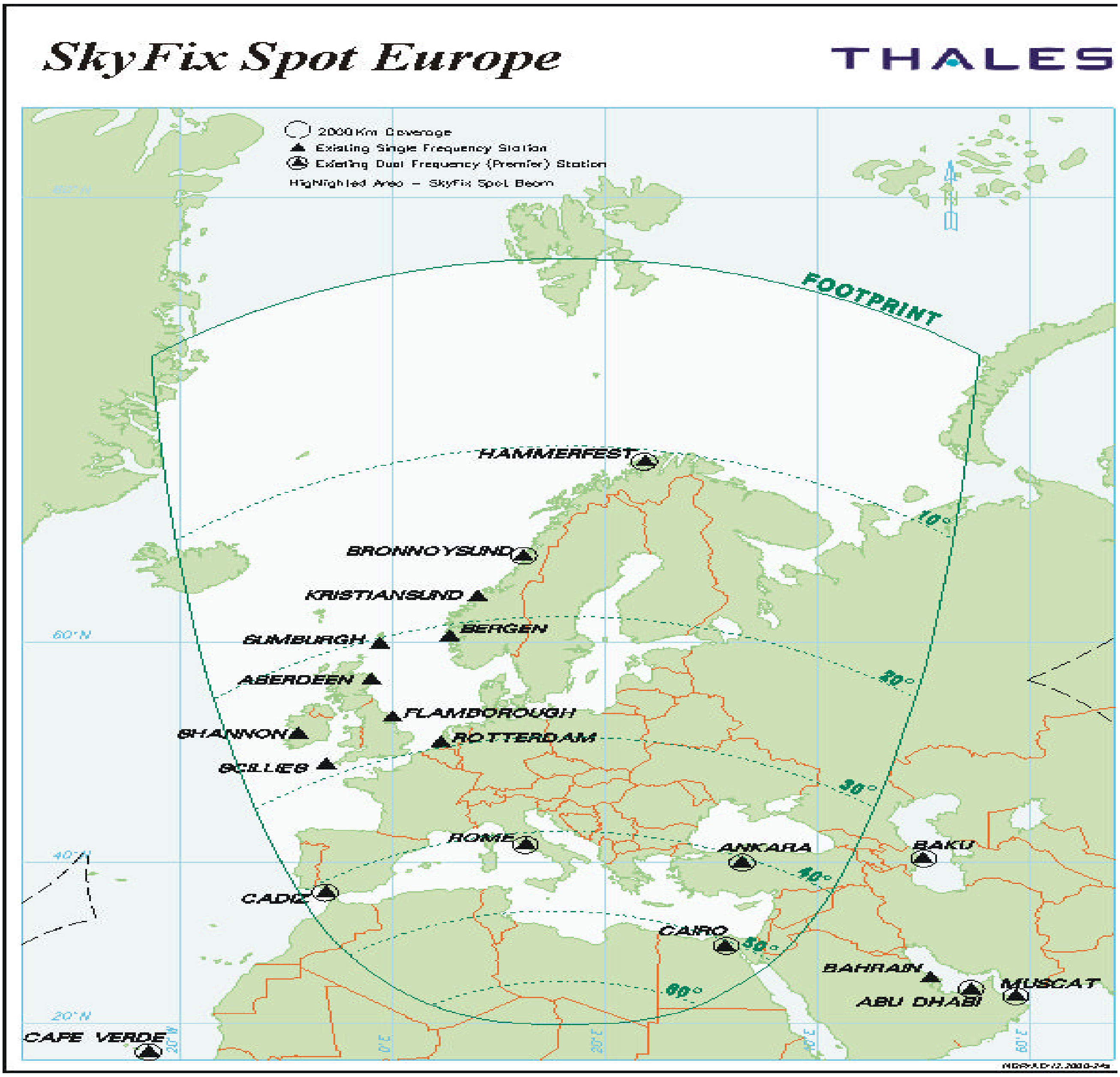
After modifying the 2-boat link antenna, so that all disruptions were outside the survey area, the navigation data quality improved significantly, and reduced the work load of sorting out data with gun drop outs, switching sequences, etc.

20 Navigation Exhibits

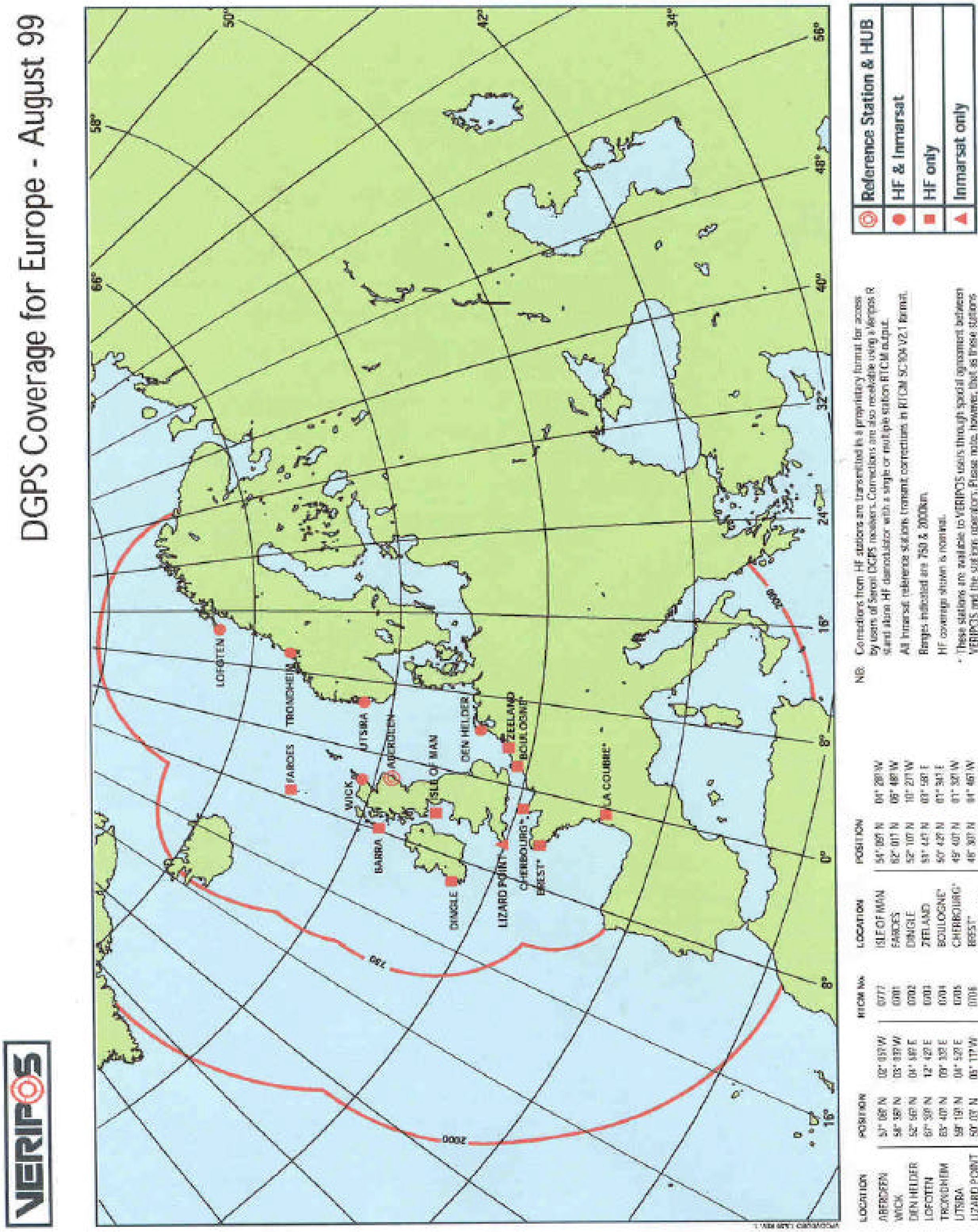
Exhibit 1 : **Navigation System**

- **<u>DGPS Coverage Maps for RTCM Sources</u>**

<u>Thales Skyfix European Coverage Map</u>



Osiris Veripos European Coverage Map



GPS System Installation Forms

VESSEL:	Geco Angler	SHEET 1 OF 2
DGPS SYSTEM:	Trinav-GPS	
DATE:	August 2001	

CHECK		**ACTIVE UNIT**	**SPARE UNIT**
GPS receiver	type	Novatel Millennium	Novatel Millenium
	serial no.	unit1	unit2
	no. channels	12	12
	software		
	firmware	ver. 4.503	V 4.503
GPS Antenna	type	Leica DF	
	serial no.	n/k	n/k
Cables	max. recommended length		
	actual length	30m	
	type	Andrews low loss	
	line amps installed Y/N	No	
	joints checked Y/N	Yes	
Satellite link	Correct Inmarsat antenna splitter used Y/N	N/A	N/A
	demodulator serial number	Skyfix – 1938 Starfix – 042086	Skyfix – 1978 Starfix - 042763
	demodulator frequency	Skyfix - Starfix – 65137500	Skyfix – Starfix – 65137500
Radio link	frequency	Spotbeam	Spotbeam
Raydome blind spots relative to ship's head			
Contractor computer	type	N/A	N/A
	serial no.		
	program version		
Virus Check	Y/N		
	program version		
	result		
Visual inspection installation	Y/N		
Units securely mounted	Y/N	Y	Y
Power on check	Y/N	Y	Y
Manuals onboard	Y/N	Y	Y
DGPS software	name, version	Trinav 2.6.0 patch level18	Trinav 2.6.0 patch level18
Data output format to RT		RTCM 104	RTCM 104
Interfaced to RT		yes	
Satellite selection mode		All in view	All in view
Position calculation mode fixed/constrained		Height aiding	Height aiding
Antenna height above MSL		22.98m	22.98m
Geoid-spheroid separation		N/A	N/A
Std dev of antenna height input		2	2
PDOP limit		No	No
Elevation mask		5 deg	5 deg
SV Sync time		1 sec	1 sec
Max age corrections		150 sec	150 sec

	Name (Print)	Signature
Installed by:	______________________	______________________
Company	______________________	
Positioning Supervisor:	______________________	______________________

VESSEL: Geco Angler	SHEET: 1 OF 1
DGPS SYSTEM: OSIRIS VERIPOS	
DATE: May 2002	

CHECK		ACTIVE UNIT	SPARE UNIT
GPS receiver	type	Sercel NR 203	Sercel NR 203
	serial no.	278	317
	no. channels	12	12
	software	3.1, 23.07.98	3.1, 23.07.98
	firmware	n/a	n/a
GPS Antenna	type	Sercel	Sercel
	serial no.	n/a	n/a
Cables	max. recommended length	100	100
	actual length	40	40
	type	RG 214	RG 214
	line amps installed Y/N	N	N
	joints checked Y/N	Y	Y
Satellite link	MDome Checked Y/N	Y	Y
Radio link	frequency	n/a	n/a
Raydome blind spots relative to ship's head		None	None
Contractor computer	type	n/a	n/a
	serial no.	n/a	n/a
	program version	n/a	n/a
Virus Check	Y/N	n/a	n/a
	program version	n/a	n/a
	result	n/a	n/a
Visual inspection installation	Y/N	Y	Y
Units securely mounted	Y/N	Y	Y
Power on check	Y/N	Y	Y
Manuals onboard	Y/N	Y	Y
DGPS software	name, version	same as above	same as above
Data output format to RT		G-P Standard Pos	G-P Standard Pos
Interfaced to RT		Yes	No
Satellite selection mode		All in view	All in view
Position calculation mode fixed/constrained		Height aiding	Height aiding
Antenna height above MSL		27,38m	27,38m
Geoid-spheroid separation			
Stdev of antenna height input			
PDOP limit		No	No
Elevation mask		10 deg	10 deg
SV Sync time		1 sec	1 sec
Max age corrections		25 sec	25 sec

	Name (Print)	Signature
Installed by:	Gordon Masson	
Company	Halliburton Subsea	
Positioning Supervisor:	Peter Durran (WesternGeco)	

VESSEL:	Western Inlet	SHEET: 1 OF 1
DGPS SYSTEM:	Posnet	
DATE:	May 2002	

CHECK		ACTIVE UNIT	SPARE UNIT
GPS receiver	type	Trimble 4000 SSE	Trimble 4000 SSE
	serial no.	3252A02246	3338A04041
	no. channels	18	18
	Software		
	Firmware	7.29	7.29
GPS Antenna	type	Geodetic	Geodetic
	serial no.	3301A66934	80126803
Cables	max. recommended length		
	actual length		
	Type	Andrews	Andrews
	line amps installed Y/N	No	
	joints checked Y/N	Yes	
Satellite link	Correct Inmarsat antenna splitter used Y/N	N/A	
	demodulator serial number	N/A	
	demodulator frequency	N/A	
Radio link	frequency	N/A	
Raydome blind spots relative to ship's head		N/A	
Contractor computer	type	Dell Optiplex GXPro	Dell Workstation 400
	serial no.	7TN5W	C690L
	program version	Windows NT	Windows NT
Virus Check	Y/N	N/A	
	program version	N/A	
	Result	N/A	
Visual inspection installation	Y/N	Yes	
Units securely mounted	Y/N	Yes	
Power on check	Y/N	Yes	
Manuals onboard	Y/N	Yes	
DGPS software	name, version	Posnet, V1.78	
Data output format to RT		N/A	
Interfaced to RT		N/A	
Satellite selection mode		Auto	
Position calculation mode	fixed/constrained	Constr.	
Antenna height above MSL		21.32	
Geoid-spheroid separation			
Stdev of antenna height input			
PDOP limit			
Elevation mask		10 deg	
SV Sync time			
Max age corrections			

	Name (Print)	Signature
Installed by:	Wayne Davis	
Company	WesternGeco	
Positioning Supervisor:	Stuart Porteous	______________________

- **TRINAV GPS Integrity Monitor Station Description**

GPS INTEGRITY MONITOR			
Country: **Norway**	**Area:** **Asker**		**Station name:** **Asker**
Communication: **Norsat connection only**			
Co-ordinates		**Datum**	
Latitude: Longitude: Ellipsoidal Height:	59 49' 56.09123" N 10 24' 56.86740" W 201.872 m	Ellipsoid: Semi Major axis: Inverse Flattening: Datum:	WGS-84 6378137.0 m 1/298.257 223 563 WGS-84 (ITRF94)
Description of station: The station is located on the roof of WesternGeco's office at Asker. The cable run from the antenna to the receiver is approximately 80m. Postal address: WesternGeco, Schlumberger House, Solbraaveien 23, N-1372 Asker, Norway			
Antenna: GPS L1/L2 antenna Model 503 is used for high-performance position-reference stations, and it features a built in choke ring ground plane to minimize the effect of multi-path interference. The antenna is mounted on a pole on top of the plant room. There are no obstructions between the antenna and the satellites. Serial No.: 7096.503			
Receiver unit: The unit in use at the Integrity Monitor Station is a NovAtel MiLLennium dual frequency receiver. Serial No.: NGY 00260016			
Observation and Processing method: Fugro-Geoteam has surveyed 6 antenna positions and two witness marks on the roof of the Schlumberger House in Asker. The points were obtained by GPS carrier phase measurements using Oslo and Kristiansand SATREF stations as known stations. Dual-frequency carrier phase data was logged for 1 hr 41 min and 2hrs 37 min. for the Integrity Monitor station. Files with 24 hours of GPS observations from the Oslo and Kristiansand SATREF stations for the 15th of September were received from the Norwegian mapping authority. Baselines were calculated using the Wave module included in Trimble Ltd's software GPSurvey. The network was adjusted using Trimble Ltd's software Trimnet Plus.			
Date of survey: 15 September, 2000			

Exhibit 2 : **Echo Sounder Calibration**

Geco-Angler

ANG_0130_ES

Vessel:	Geco Angler	**Date :**	30-Jan-02
Client:	BP	**Check started (GMT):**	10:23
Job no.	9214	**Check ended (GMT):**	10:26
Location:	Alongside Surabaya	**E/S draught:**	5.30
E/S type:	EA500	**Vertical offset keel to E/S:**	0.00
Serial no:	1703P75A1	**Bridge E/S reading**	?

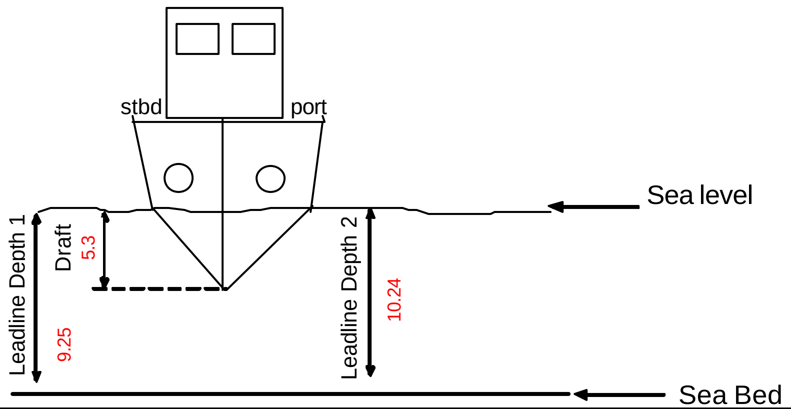
Observed					**Echo Sounder Readings**
Draught (m)			Lead Line Depth (m)		Depth (m)
Bow	Mid-ships	Stern	Stbd (1)	Port (2)	
5.30	n/a	7.10	9.25	10.24	Readings are recorded using RTDisplay and are then averaged for the whole period of measurement
Draught at E/S		**5.30**	LL Depth at E/S	**9.75**	

Average =	**4.00**
+ vertical offset keel to E/S transducer	0.00
+ draught (keel to sea surface)	5.30
Total water depth (m)	**9.30**

Observed - Echo Sounder = 0.45 m

This difference could be explained by the slope of the sea bed under the e/s from starboard to port

Sounder Settings Check:	**Factory Defaults (from manual)**	**Check**
RangeA	50	
Absorption coefficient	6 dBkm	
Transmit power	Nomal	
Transducer Depth	0.0m	
Speed of sound	1500 mps	
two way beam angle	-20.6 dB	
Transducer gain	-20 dB	
Sample distance	0.2m	



Western Inlet

Echo Sounder Check (In Port)

WesternGeco

INL_0218_ES

Vessel:	M/V W. Inlet	**Date :**	20020430
Client:	Statoil	**Check started (GMT):**	10:25
Job no.	9238	**Check ended (GMT):**	10:28
Location:	Dockside Ulsteinvik	**E/S draught:**	4.43
E/S type:	Simrad	**Vertical offset keel to E/S:**	N/A
Serial no:	1033	**Bridge E/S reading**	N/A

Observed

	Time (UTC)	Lead Line Depth (m)	Transducer Depth (m)	Depth (m) @ Transducer
Port	10:28	15.86	8.01	7.85
Starboard	10:25	13.40	8.01	5.39
			LL Depth at E/S	**6.62**

Echo Sounder Readings

Time (UTC)	Depth (m)
10:28	7.20
10:25	7.20
Average =	**7.20**

Observed - Echo Sounder = -0.58 m

Note: The 18 kHz transducer was used during the check. The transducer depth is a surveyed measurement from the transducer face to the vessel's forecastle deck at marked locations, corresponding to the location of transducer, on the Stbd. and Port side

Sounder Settings Check:	**Factory Defaults (from manual)**	**Check**
RangeA	5500 m	
Absorption coefficient	6 dBkm	
Transmit power	Normal	
Transducer Depth	0.00 m	
Speed of sound	1500 m/s	
two way beam angle	-14.5 dB	
Transducer gain	16.3 dB	
Sample distance	0.25 m	

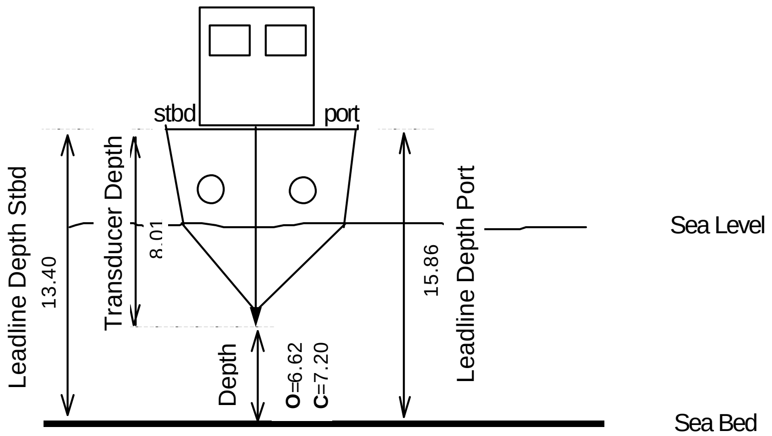


Exhibit 3 : **GPS and Gyro Calibration**

- **Offshore Calibration Report**

OFFSHORE CALIBRATION REPORT

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I. Introduction

During the seismic survey undertaken by M/V Geco Angler and Western Inlet for STATOIL from 13th June 2002 to 16 July 2002 in the Volve Block (WesternGeco job number 9238), the DGPS, rGPS and Gyro positioning systems were monitored continuously throughout acquisition. This allowed C-O values to be computed, monitored and modified, if necessary, whilst offshore. These offshore calibration techniques have been developed by WesternGeco – the principal components comprise:

- The Integrity Monitor, one of several shore reference stations where a GPS receiver and data link are established at a known coordinated point allowing comparisons of the vessel GPS receiver performance against the reference receiver.
- The RT Calib system that uses the Primary vessel GPS together with a second GPS installation at a predetermined point on the vessel to determine a heading vector against which the vessels Gyros may be calibrated.

The technique for these is described in **WesternGeco's Navigation systems – a Technical Introduction,** which is available upon demand.

The report presents the observations and results from these offshore calibrations.

II. Differential GPS Verification

M/V Geco Angler & Western Inlet utilised the following DGPS systems throughout the survey: a Leica MX9400 GPS receiver providing raw pseudo range data to WesternGeco's TRINAV GPS 2.6 for Primary vessel positioning with Thales RTCM corrections delivered by a Spotbeam Skyfix System and also Osiris RTCM corrections delivered by an Inmarsat B Veripos system.

Secondary vessel positioning was provided by Osiris DGPS with Osiris RTCM corrections delivered by Inmarsat B Veripos System.

Tertiary vessel positioning was provided by a Posnet DGPS with direct injection of Osiris RTCM corrections delivered by Inmarsat B Veripos System.

Data transfer between the vessel and the Integrity Monitor Receiver was achieved using the vessel's Norsat C satellite data link.

Method used

Refer to **WesternGeco's Navigation systems – a Technical Introduction**, DGPS Calibrations Integrity Monitor section.

Results

Chapter VI contains a summary of the statistics taken from the diagnostics files.

Chapter VII contains numerical data from rtcalib for the integrity monitor.

Figure 1 shows the average disclosure of the integrity monitor station in graphical form (separated into northing and easting misclosures) for several of the sequences acquired. For ease of interpretation, separate displays are also included to allow any line heading dependency of the GPS positioning to be ascertained.

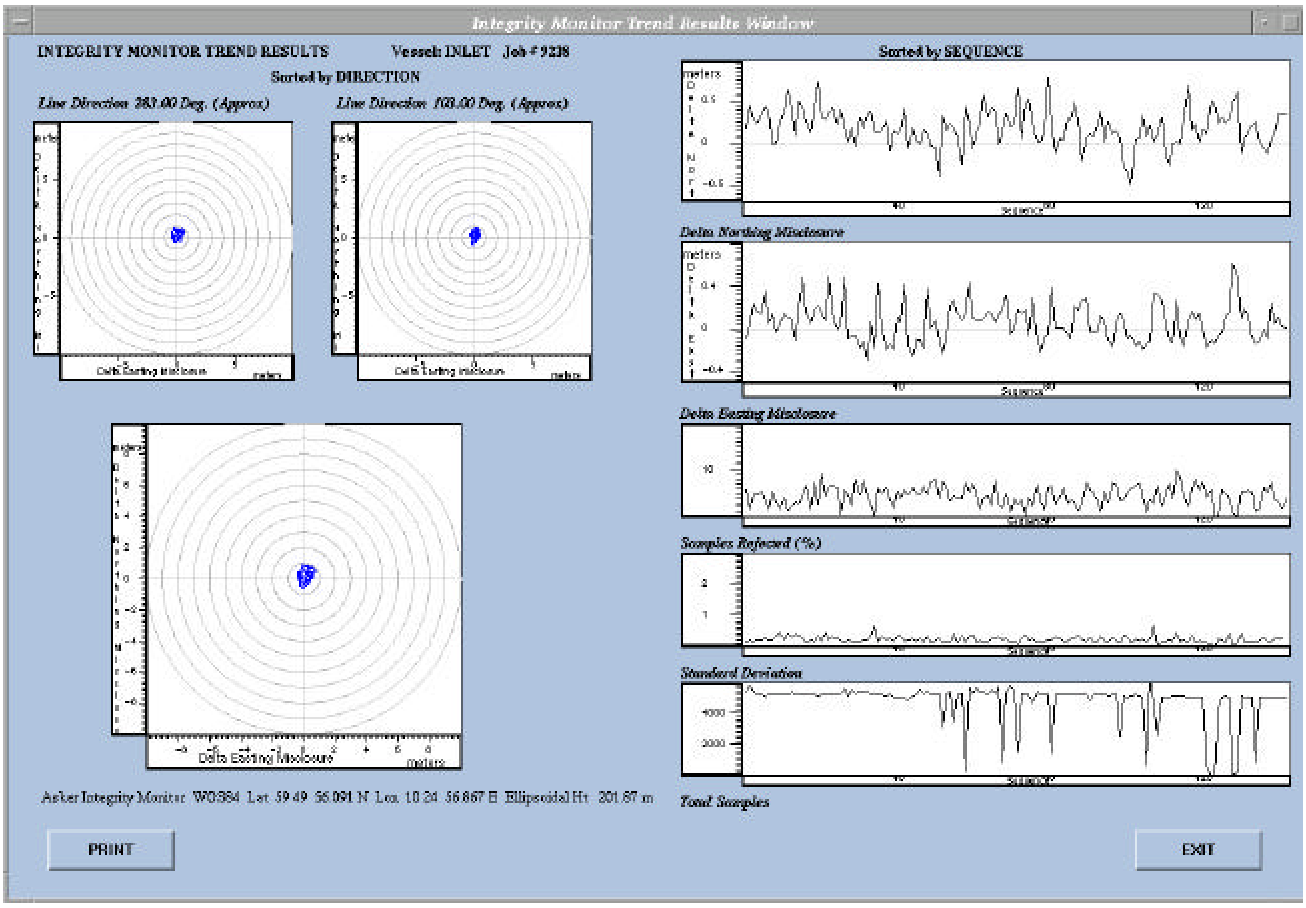


Figure 1: Integrity Monitor Plot Trends to demonstrate GPS quality during the calibrations

III. rGPS Verification

M/V Western Inlet utilised WesternGeco's Posnet rGPS system throughout this survey for Source positioning. For rGPS verification purposes the GPS signal received by the main Posnet GPS vessel receiver is split using a purpose designed GPS splitter. It is then used by both the main vessel receiver and transferred to a re-radiating antenna on the back deck, allowing use of a near identical GPS signal by SPU and vessel receiver simultaneously.

Method used

Refer to **WesternGeco's Navigation systems – a Technical Introduction**, rGPS Calibrations section.

Results

A summary of the statistics taken from data collected using the calibration option in the Spectra Utility Node.

To see the table showing the statistical printouts and a summary of the stats, then select a link to the float required….

G1R1 Calibration Spreadsheet

G1R2 Calibration Spreadsheet

G1R3 Calibration Spreadsheet

G2R1 Calibration Spreadsheet

G2R2 Calibration Spreadsheet

G2R3 Calibration Spreadsheet

IV. Gyro Calibration

M/V Western Inlet is fitted with two gyrocompasses, a main survey gyro and a secondary gyro for comparison and backup use. Both gyros are of the type Sperry Mark 23. TRINAV GPS is used to determine the heading vector, for comparison with the Gyro headings. This utilises the standard vessel receiver as described above and a second receiver, of the same type. The second receiver's antenna is mounted 30.3 m ahead of the primary receiver's, with the minimum practicable difference in height. The positions of all antennas used in the Gyro calibration process are determined during a high precision Offset Measurement Survey, performed by an independent contractor, whilst the Vessel is in dock or alongside.

Method used

Refer to **WesternGeco's Navigation systems – a Technical Introduction**, Gyro Calibrations section.

Results

Results from RT Calib are shown in tabular form in chapter VII.

V. Secondary & Tertiary DGPS System Differences to TRINAV GPS

The following table contains a summary of the statistics taken from the diagnostics file.

Line name	Seq	Posnet Difference	Veripos Difference	Line name	Seq	Posnet Difference	Veripos Difference
S01P5023003	3	1.31	2.04	S01P5011004	4	0.30	2.47
S01P5035005	5	0.88	2.28	S01P5003006	6	0.80	2.35
S01P5007007	7	2.23	2.16	S01P5031008	8	1.47	2.39
S01P4999009	9	1.75	1.91	S01P5027010	10	1.63	2.75
S01P4995011	11	0.70	1.87	S01P5039012	12	1.15	2.70
S01P4991013	13	1.41	2.21	S01P4963014	14	1.82	2.33
S01P4987015	15	0.98	2.24	S01P5043016	16	0.90	2.44
S01P4983017	17	1.54	2.05	S01P5047018	18	0.52	2.59
S01P4967019	19	1.09	2.00	S01P5051020	20	2.70	2.93
S01P4979021	21	0.82	2.30	S01P4971022	22	0.90	2.45
S01P5055023	23	1.45	2.43	S01P5015024	24	1.24	2.74
S01P4975025	25	2.24	2.11	S01P5019026	26	1.19	2.65
S01P5103027	27	1.33	2.24	S04P5071028	28	1.52	2.33
S04P5099029	29	1.27	2.26	S04P5063030	30	1.26	2.93
S04P5095031	31	0.83	1.81	S04P5067032	32	1.10	2.83
S04P5091033	33	2.60	1.98	S04P5087034	34	1.67	2.46
S04P5059035	35	1.13	2.20	S04P5111036	36	1.24	2.16
S04P5079037	37	0.93	2.27	S04P5107038	38	0.61	2.56
S04P5075039	39	0.68	2.20	S04P5115040	40	0.75	2.16
S04P5083041	41	0.53	2.36	S04P4119042	42	1.02	2.15
S04P5123044	44	1.19	1.83	S04P5147045	45	1.13	2.02
S04P5127046	46	2.14	2.41	S04P5151047	47	1.64	2.34
S04P5139048	48	1.53	2.21	S04P5131049	49	0.91	1.51
S04P5143050	50	2.48	2.14	S04P5135051	51	1.65	2.45
S06P5171052	52	2.71	2.29	S06P5195053	53	0.96	2.17
S06P5175054	54	1.46	2.32	S06P5199055	55	1.23	2.39
S06P5179056	56	1.25	2.46	S06P5203057	57	1.38	2.12
S06P5183058	58	1.69	2.54	S06P5163059	59	0.87	2.08
S06P5139060	60	0.76	2.39	S06P5167061	61	1.36	2.30
S06P5135062	62	1.92	2.29	S06P5159063	63	1.83	2.24
S06P5143064	64	1.03	2.22	S06P5123066	66	0.75	2.01
S06P5147067	67	1.54	3.01	S06P5127068	68	1.37	2.10
S06P5151069	69	1.98	2.67	S06P5131070	70	1.30	1.83
S06P5155071	71	1.37	2.41	S06P5207072	72	0.93	2.07
S06P5187073	73	1.07	2.30	S06P5211074	74	1.14	2.21
S06P5123075	75	1.10	2.09	S06P5191076	76	0.93	2.02
S06P5217077	77	0.85	1.97	S03P5087078	78	1.27	2.54
S03P5079079	79	1.39	2.19	S03P5103080	80	0.96	2.40
S03P5099082	82	0.53	2.15	S03P5083083	83	1.49	2.55
S03P5075084	84	1.35	2.12	S03P5107085	85	0.79	2.31

S03P5119086	86	0.76	2.56	S03P5099087	87	1.62	2.46
S03P5095088	88	1.10	2.48	S03P5067089	89	1.00	2.38
S03P5043090	90	2.30	2.39	S03P5071091	91	0.79	2.11
S03P5047092	92	2.01	2.60	S03P5063093	93	0.67	2.31
S03P5039094	94	0.98	2.11	S03P5059095	95	1.98	2.53
S03P5027096	96	0.82	2.43	S03P5055097	97	0.85	1.95
S03P5031098	98	1.12	2.25	S03P5051099	99	1.40	2.06
S03P5035100	100	2.45	2.50	S03P5111101	101	1.31	2.17
S03P5091102	102	1.88	2.63	S03P5115103	103	1.22	2.37
S02P5051104	104	1.18	2.09	S02P5075105	105	1.66	2.56
S02P5047106	106	0.90	2.23	S02P5071107	107	1.78	2.39
S02P5035109	109	1.66	2.15	S02P5059110	110	1.54	2.51
S02P5007112	112	1.80	2.34	S02P5039113	113	1.02	2.37
S02P5063114	114	0.92	2.36	S02P5031115	115	1.51	2.38
S02P5003116	116	1.92	2.56	S02P5027117	117	1.72	2.19
S02P4999118	118	1.79	2.50	S02P5023119	119	0.95	2.25
S02P4995122	122	1.75	2.14	S02P5019123	123	0.83	2.42
S02P5043124	124	0.62	2.41	S02P5011125	125	0.54	2.50
S02P5067126	126	0.26	2.22	S02P5051127	127	1.14	2.52
S02P5003128	128	1.69	2.58	S02P5023130	130	0.82	2.45
S02P4999131	131	1.23	2.28	S02P5079132	132	0.52	2.15
S02P5087133	133	0.56	2.68	S02P5055134	134	0.44	2.14
S02P5083135	135	1.23	2.53	S02P5147136	136	0.35	2.30
S02P5171137	137	0,03	2.36	S05P5143138	138	0.27	2.27
S05P5167139	139	0.31	2.30	S05P5139140	140	0.87	2.45
S05P5151141	141	0,04	2.51	S05P5179142	142	0.81	2.19
S05P5155143	143	0.56	2.58	S05P5131145	145	0.49	2.16
S05P5107146	146	0.13	2.50	S05P5135147	147	0.26	2.22
S05P5111148	148	1.13	2.24	S05P5127249	149	0.03	2.19
S05P5099150	150	1.07	2.51	S05P5123121	151	0.94	2.25
S05P5095152	152	1.19	2.59	S05P5131153	153	1.45	2.12
S05P5103154	154	0.49	2.64	S05P5115155	155	0.44	2.27
S05P5091156	156	0.10	2.37	S05P5119157	157	0.21	2.13
S05P5159158	158	0.82	2.72	S05P5175159	159	0.28	2.14
S05P5163160	160	0.33	2.49	S05P5183161	161	0.79	2.26

END OF SURVEY…

VI. Line by Line Results from RT Calib for Gyros and Integrity Monitor

SWATH 01…

Seq	LineID	Mins	HdgSOL	HdgEOL	Gyro	C-O	STD	Samp	Rej%
1	S01P5019001	81	283	284	GY01	1.78	0.39	4749	3.6
2	S01P5015002	84	105	109	GY01	1.91	0.32	4894	2.9
3	S01P5023003	79	269	269	GY01	2.65	0.49	3928	1.5
4	S01P5011004	79	114	113	GY01	2.72	0.37	4569	3
5	S01P5035005	78	268	276	GY01	2.45	0.44	4508	4.6
6	S01P5003006	81	107	106	GY01	2.18	0.54	4598	4.3
7	S01P5007007	80	273	277	GY01	2.44	0.57	4240	3.6
8	S01P5031008	80	108	104	GY01	2.15	0.4	4625	5.4
9	S01P4999009	79	275	280	GY01	2.65	0.49	3914	4.1
10	S01P5027010	79	98	100	GY01	2.22	0.48	4603	4.4
11	S01P4995011	79	282	281	GY01	2.4	0.52	4358	3.2
12	S01P5039012	77	105	105	GY01	2.37	0.58	4349	3.2
13	S01P4991013	79	276	276	GY01	2.05	0.53	4695	4.9
14	S01P4963014	78	105	102	GY01	2.7	0.45	4096	3.6
15	S01P4987015	78	285	283	GY01	2.88	0.42	2954	4.8
16	S01P5043016	78	101	101	GY01	2.45	0.49	4484	3.7
17	S01P4983017	79	276	270	GY01	2.55	0.42	4594	3.6
18	S01P5047018	78	113	112	GY01	1.97	0.34	4570	3.9
19	S01P4967019	77	284	282	GY01	2.72	0.34	4502	3.8
20	S01P5051020	76	103	106	GY01	2.4	0.51	4386	3.1
21	S01P4979021	78	276	272	GY01	2.78	0.33	4174	3.5
22	S01P4971022	78	102	100	GY01	2.39	0.62	3959	1.7
23	S01P5055023	78	285	281	GY01	2.82	0.31	4449	3.6
24	S01A5015024	79	128	118	GY01	1.88	0.63	4540	4.7
25	S01P4975025	79	270	271	GY01	2.98	0.4	2067	4.4
26	S01A5019026	79	107	100	GY01	2.3	0.75	3696	4.2
				Mean…		2.42	0.47	4250	3.74

SWATH 02…

Seq	LineID	Mins	HdgSOL	HdgEOL	Gyro	C-O	STD	Samp	Rej%
99	S02P4995120	78	110	107	GY01	2.6	0.5	4118	3.9
100	S02A4995121	32	270	269	GY01	2.85	0.42	1098	4.5
101	S02B4995122	76	93	92	GY01	3.05	0.24	4104	3.6
102	S02P5019123	75	290	286	GY01	3	0.31	2943	4.1
103	S02P5043124	75	97	98	GY01	2.9	0.22	4381	4.7
104	S02P5011125	76	101	98	GY01	2.73	0.37	4428	2.3
105	S02P5067126	76	283	286	GY01	2.55	0.44	4269	2.9
106	S02P5015127	76	97	97	GY01	2.88	0.3	3898	3
107	S02A5003128	2	106	107	GY01	2.76	0.26	98	3.1
108	S02A5023129	84	275	276	GY01	2.91	0.32	4467	2.8
109	S02B5023130	75	101	97	GY01	2.34	0.67	4016	4.8
110	S02A4999131	33	100	103	GY01	2.96	0.31	1535	3.3
111	S02P5079132	75	277	274	GY01	2.76	0.36	4233	3.2
112	S02P5087133	75	107	106	GY01	3.04	0.27	3632	4.4
113	S02P5055134	75	276	275	GY01	3.17	0.22	2364	4.4
114	S02P5083135	76	105	104	GY01	2.69	0.38	4374	3.3
				Mean…		2.32	0.41	4175	3.3

SWATH 03…

Seq	LineID	Mins	HdgSOL	HdgEOL	Gyro	C-O	STD	Samp	Rej%
72	S03P5087078	78	100	102	GY01	3.12	0.28	1024	5.5
73	S03P5083	16	106	104	GY01	2.98	0.33	693	4.5
74	S03P5079079	78	94	93	GY01	2.73	0.45	3877	4.2
75	S03P5103080	78	290	293	GY01	3.16	0.23	2192	4.4
76	S03P5075081	76	93	96	GY01	2.87	0.35	3833	3.5
77	S03P5099082	68	284	281	GY01	2.86	0.3	3902	3
78	S03P5083083	79	105	102	GY01	2.93	0.34	3906	3.5
79	S03A5075084	78	281	284	GY01	2.81	0.34	4062	2.6
80	S03P5107085	78	101	105	GY01	3.12	0.25	2700	3.8
81	S03P5119086	77	276	273	GY01	2.94	0.31	3863	3
82	S03A5099087	13	272	271	GY01	3.06	0.25	641	3.3
83	S03P5095088	77	110	109	GY01	2.66	0.44	4366	3.3
84	S03P5067089	78	277	277	GY01	3.26	0.18	670	3.3
85	S03P5043090	78	107	106	GY01	2.97	0.32	3841	4.1
86	S03P5071091	78	272	271	GY01	3.18	0.24	1308	5.8
87	S03P5047092	77	109	108	GY01	2.77	0.5	3155	4.1
88	S03P5063093	77	270	274	GY01	2.93	0.38	2860	4.2
89	S03P5039094	77	105	102	GY01	2.89	0.39	3380	4.2
90	S03P5059095	77	278	281	GY01	3.14	0.27	1330	4.8
91	S03P5027096	77	108	111	GY01	2.93	0.35	3338	3.9
92	S03P5055097	77	273	276	GY01	3.13	0.26	1911	4.6
93	S03P5031098	77	108	101	GY01	3.02	0.29	3537	4.4
94	S03P5051099	77	281	280	GY01	3.11	0.3	1497	5
95	S03P5035100	77	99	98	GY01	2.58	0.54	3899	3.8
96	S03P5111101	78	279	272	GY01	3.05	0.34	1250	5.1
97	S03P5091102	77	109	107	GY01	2.71	0.48	3717	4.3
98	S03P5115103	77	275	274	GY01	2.8	0.48	2495	4.3
				Mean…		**2.95**	**0.34**	**2713**	

SWATH 04…

Seq	LineID	Mins	HdgSOL	HdgEOL	Gyro	C-O	STD	Samp	Rej%
27	S04P5103027	84	272	270	GY01	2.8	0.48	3419	4.9
28	S04P5071028	78	114	112	GY01	1.74	0.92	4175	3.6
29	S04P5099029	83	264	272	GY01	2.61	0.57	3552	3.9
30	S04P5063030	79	110	118	GY01	1.79	0.98	4037	4.1
31	S04P5095031	82	272	273	GY01	2.46	0.65	3582	4.4
32	S04P5067032	81	111	106	GY01	2.05	0.83	4252	4.1
33	S04P5091033	80	273	273	GY01	2.28	0.69	4128	4.1
34	S04P5087034	78	107	105	GY01	2.27	0.72	3990	3.9
35	S04P5059035	80	270	278	GY01	2.75	0.44	3993	2.6
36	S04P5111036	20	101	99	GY01	2.98	0.37	484	3.3
37	S04P5079037	22	282	280	GY01	2.95	0.42	450	4.2
38	S04P5107038	10	113	116	GY01	2.07	0.92	502	1.4
39	S04P5075039	19	270	273	GY01	1.45	0.63	353	6.2
40	S04P5115040	77	110	106	GY01	2.39	0.64	3912	4.7
41	S04P5083041	12	271	269	GY01	2.3	0.45	438	10.7
42	S04P5119042	76	113	114	GY01	2.18	0.62	3535	3.5
43	S04P5143043	78	271	276	GY01	2.63	0.63	933	7.1
44	S04P5123044	76	102	106	GY01	2.87	0.28	4364	2.9
45	S04P5147045	78	275	269	GY01	2.59	0.51	1545	3.8
				Mean…		**2.38**	**0.62**	**2718**	

SWATH 05

Seq	LineID	Mins	HdgSOL	HdgEOL	Gyro	C-O	STD	Samp	Rej%
115	S05P5147136	75	287	282	GY01	2.81	0.4	3324	3.8
116	S05P5171137	76	101	103	GY01	2.55	0.45	4403	3.5
117	S05P5143138	76	269	277	GY01	2.34	0.54	4429	3
118	S05P5167139	75	107	104	GY01	3.11	0.25	3183	3.9
119	S05P5139140	75	283	286	GY01	2.6	0.41	4310	3.6
120	S05P5151141	75	108	112	GY01	2.67	0.29	4347	4.7
121	S05P5179142	75	270	271	GY01	2.4	0.34	4453	4.7
122	S05P5155143	75	116	110	GY01	2.3	0.24	4456	5.2
126	S05A5131145	64	283	277	GY01	3.07	0.34	3255	7.3
127	S05P5107146	75	109	111	GY01	3.14	0.19	3953	2.8
128	S05P5135147	76	271	271	GY01	2.35	0.22	4505	4.8
129	S05P5111148	74	111	107	GY01	2.73	0.22	4414	5.6
132	S05P5127149	76	282	286	GY01	3.09	0.21	2963	4.2
133	S05P5099150	74	100	103	GY01	2.96	0.23	4362	3.3
134	S05P5123151	75	279	272	GY01	2.53	0.21	4417	4.4
135	S05P5095152	75	104	98	GY01	2.17	0.22	4464	4.5
136	S05B5131153	5	284	284	GY01	2.61	0.18	273	4.4
137	S05P5103154	75	102	104	GY01	2.74	0.25	4430	4
138	S05P5115155	75	282	281	GY01	2.59	0.32	4436	4.1
139	S05P5091156	75	102	99	GY01	2.22	0.21	4363	4.7
140	S05P5119157	75	284	283	GY01	2.39	0.26	4419	7.6
141	S05P5159158	75	108	108	GY01	2.2	0.28	4475	3.7
142	S05P5175159	74	274	273	GY01	2.2	0.17	4412	6.8
143	S05P5163160	74	102	102	GY01	2.41	0.46	4440	7
144	S05P5183161	75	282	282	GY01	1.91	0.25	4434	5.2
				Mean…		**2.14**	**0.23**	**4236**	

SWATH 06…

Seq	LineID	Mins	HdgSOL	HdgEOL	Gyro	C-O	STD	Samp	Rej%
53	S06P5163059	78	269	270	GY01	2.83	0.41	3927	1.8
54	S06P5139060	78	111	107	GY01	2.49	0.24	4599	5.2
55	S06P5167061	79	276	274	GY01	3.06	0.28	2935	4.2
56	S06P5135062	78	109	110	GY01	2.61	0.47	4412	3.6
57	S06P5159063	81	272	270	GY01	2.97	0.33	3201	4.4
58	S06P5143064	78	101	99	GY01	2.49	0.58	3841	3.7
60	S06A5123066	84	263	258	GY01	3.03	0.36	1182	5.2
61	S06P5147067	78	112	108	GY01	2.05	0.94	3539	4.2
62	S06P5127068	84	277	284	GY01	2.4	0.73	3162	4
63	S06P5151069	80	94	89	GY01	2.52	0.7	2567	4.9
64	S06P5131070	80	283	280	GY01	2.91	0.42	2264	4.8
65	S06P5155071	78	104	106	GY01	2.68	0.57	2171	4
66	S06P5207072	82	275	282	GY01	2.7	0.49	3479	4.1
67	S06P5187073	79	103	104	GY01	2.67	0.6	2214	4.8
68	S06P5211074	84	284	292	GY01	2.91	0.39	2878	4.5
69	S06B5123075	4	291	290	GY01	2.96	0.41	102	4.9
70	S06P5191076	80	92	94	GY01	2.58	0.62	2697	4.5
71	S06P5215077	84	287	277	GY01	2.91	0.4	2711	4.5
				Mean…		**2.71**	**0.50**	**2882**	

VII. Line by Line Results from RT Calib for Integrity Monitor

Swath 01

Seq	Lline	Mins	HdgSOL	HdgEOL	North Delta	Std	South Delta	Std	Samp
1	S01P5019001	91	282	284	0.19	0.14	-0.08	0.13	5459
2	S01P5015002	97	104	109	0.45	0.2	0.03	0.09	5775
3	S01P5023003	89	272	269	0.29	0.16	0.23	0.11	5310
4	S01P5011004	89	113	113	0.24	0.22	0.17	0.11	5261
5	S01P5035005	88	271	276	0.34	0.21	0.14	0.18	5289
6	S01P5003006	88	106	103	0.44	0.25	0.35	0.1	5053
7	S01P5007007	89	276	277	0.37	0.2	0.05	0.09	5301
8	S01P5031008	88	108	109	-0.01	0.2	0.14	0.11	5276
9	S01P4999009	89	274	280	0	0.33	-0.02	0.19	5286
10	S01P5027010	88	97	101	0.24	0.43	0.04	0.15	5223
11	S01P4995011	89	281	281	0.38	0.19	0.14	0.1	5229
12	S01P5039012	87	102	105	0.63	0.39	0.11	0.18	5198
13	S01P4991013	89	274	276	0.43	0.27	0.09	0.1	5336
14	S01P4963014	88	106	103	0.1	0.38	-0.1	0.14	5264
15	S01P4987015	88	285	283	0.5	0.32	0.2	0.17	5274
16	S01P5043016	87	100	104	0.42	0.28	0.48	0.15	5172
17	S01P4983017	89	277	270	0.27	0.14	0.15	0.11	5304
18	S01P5047018	87	113	113	0.13	0.22	0.05	0.14	5178
19	S01P4967019	87	286	282	0.43	0.16	0.18	0.09	5185
20	S01P5051020	86	104	104	0.72	0.31	0.21	0.26	5095
21	S01P4979021	87	276	272	0.31	0.15	0.16	0.14	5223
22	S01P4971022	87	102	99	0.28	0.42	0.08	0.26	5221
23	S01P5055023	87	288	281	0.37	0.2	0.49	0.16	5229
24	S01A5015024	88	132	118	0.42	0.33	0.14	0.19	5236
25	S01P4975025	88	270	271	0.23	0.26	0	0.09	5251
26	S01A5019026	89	110	100	0.4	0.21	0.04	0.11	5267
				Mean..	**0.25**	**0.33**	**0.13**	**0.14**	**5265**

Swath 02

Seq	Lline	Mins	HdgS	HdgE	North Delta	Std	South Delta	Std	Samp
99	S02P4995120	88	115	107	0.15	0.16	0.08	0.09	5224
100	S02A4995121	42	266	269	0.06	0.11	0.15	0.12	2461
101	S02B4995122	86	93	92	-0.29	0.37	0.09	0.23	5092
102	S02P5019123	85	294	286	-0.33	0.28	-0.09	0.25	5062
103	S02P5043124	85	97	98	-0.48	0.12	-0.06	0.09	5087
104	S02P5011125	86	100	98	0.04	0.26	-0.16	0.15	5167
105	S02P5067126	85	286	286	0.05	0.16	-0.12	0.14	5107
106	S02P5015127	86	98	97	0.33	0.25	-0.19	0.16	5037
107	S02A5003128	12	106	107	0.09	0.12	-0.14	0.08	639
108	S02A5023129	107	278	276	0.22	0.24	-0.12	0.13	6342
109	S02B5023130	85	102	97	0.01	0.65	0.33	0.32	4744
110	S02A4999131	43	101	103	0.12	0.05	0.32	0.08	2561
111	S02P5079132	85	278	274	0.31	0.13	0.27	0.08	5038
112	S02P5087133	85	104	106	-0.1	0.17	0.05	0.13	4980
113	S02P5055134	85	276	275	-.25	0.22	-0.11	0.11	5041
114	S02P5083135	86	110	104	0	0.17	-0.13	0.15	5081
				Mean	**0.00**	**0.22**	**0.01**	**0.14**	**4541**

Swath 03

Seq	Lline	Mins	HdgSOL	HdgEOL	North Delta	Std	South Delta	Std	Samp
72	S03P5087078	88	98	102	0.25	0.17	0.02	0.16	5245
73	S03P5083	26	95	104	0.66	0.1	0.18	0.11	1539
74	S03P5079079	88	96	93	0.05	0.23	0.15	0.1	5285
75	S03P5103080	88	290	293	0.47	0.34	0.18	0.16	5279
76	S03P5075081	86	91	96	0.53	0.21	-0.06	0.09	5175
77	S03P5099082	78	283	281	0.24	0.23	0.29	0.12	4672
78	S03P5083083	89	105	102	0.01	0.17	-0.1	0.11	5315
79	S03A5075084	88	281	284	0.01	0.17	-0.22	0.09	5295
80	S03P5107085	88	101	105	0.18	0.15	-0.07	0.1	5263
81	S03P5119086	87	274	273	0.78	0.19	-0.05	0.13	5209
82	S03A5099087	23	268	271	0.24	0.19	0.39	0.2	1372
83	S03P5095088	87	111	109	-0.11	0.33	0.01	0.15	5227
84	S03P5067089	88	276	277	0.05	0.25	0.01	0.16	5259
85	S03P5043090	88	107	106	0.04	0.16	0.01	0.11	5261
86	S03P5071091	88	272	271	0.3	0.18	-0.05	0.21	5249
87	S03P5047092	87	109	108	0.28	0.23	-0.09	0.11	5193
88	S03P5063093	87	267	274	0.48	0.26	0.21	0.11	5184
89	S03P5039094	87	108	102	0.29	0.37	0.18	0.25	5193
90	S03P5059095	87	280	281	-0.21	0.25	0.27	0.15	5175
91	S03P5027096	87	107	111	0.07	0.15	0.29	0.14	5194
92	S03P5055097	87	272	276	0.12	0.27	-0.03	0.14	4878
93	S03P5031098	87	109	101	0.08	0.12	-0.03	0.12	5197
94	S03P5051099	87	281	280	0.21	0.18	-0.02	0.13	5200
95	S03P5035100	87	100	98	0.39	0.3	0.12	0.12	5198
96	S03P5111101	88	277	272	0.02	0.17	0.07	0.08	5251
97	S03P5091102	87	109	107	0.26	0.17	-0.1	0.11	5149
98	S03P5115103	87	272	274	0.12	0.29	-0.16	0.17	5221
				Mean..	**0.22**	**0.22**	**0.05**	**0.13**	**4914**

Swath 04

Seq	Lline	Mins	HdgSOL	HdgEOL	North Delta	Std	South Delta	Std	Samp
27	S04P5103027	93	279	270	0.21	0.13	0.48	0.14	5585
28	S04P5071028	86	111	111	0.03	0.19	-0.09	0.23	5122
29	S04P5099029	93	266	272	0.18	0.18	-0.06	0.14	5486
30	S04P5063030	89	115	118	-0.03	0.18	-0.06	0.11	5261
31	S04P5095031	92	265	273	0.31	0.15	-0.17	0.19	5459
32	S04P5067032	91	107	108	0.18	0.21	-0.12	0.12	5400
33	S04P5091033	90	273	273	0.35	0.19	-0.3	0.15	5343
34	S04P5087034	88	111	106	0.39	0.33	0.07	0.13	5242
35	S04P5059035	88	270	278	0.14	0.68	-0.18	0.29	5230
36	S04P5111036	89	104	99	0.13	0.18	0.43	0.14	5186
37	S04P5079037	87	282	280	0.16	0.3	0.03	0.17	5156
38	S04P5107038	88	116	116	0.27	0.21	-0.2	0.19	5118
39	S04P5075039	88	263	273	-0.08	0.24	-0.15	0.09	5154
40	S04P5115040	86	110	106	0.15	0.16	-0.19	0.11	5072
41	S04P5083041	84	274	269	0.12	0.31	0.11	0.26	4935
42	S04P5119042	86	113	111	0.15	0.32	0.07	0.1	5026
43	S04P5143043	87	271	276	0.41	0.16	0.42	0.14	4946
44	S04P5123044	83	103	106	-0.05	0.19	-0.15	0.18	4871
45	S04P5147045	87	273	269	0.19	0.24	-0.26	0.2	5149
				Mean	**0.17**	**0.24**	**-0.02**	**0.16**	**5197**

Swath 05

Seq	Lline	Mins	HdgSOL	HdgEOL	North Delta	Std	South Delta	Std	Samp
115	S05P5147136	85	289	282	0.02	0.45	0.27	0.13	5085
116	S05P5171137	86	101	103	0	0.18	-0.07	0.12	5111
117	S05P5143138	86	270	277	0.29	0.19	-0.16	0.2	5079
118	S05P5167139	85	124	104	0.68	0.18	0.08	0.11	5038
119	S05P5139140	85	273	286	0.17	0.31	0.16	0.2	5036
120	S05P5151141	85	107	112	0.23	0.14	0.09	0.11	4975
121	S05P5179142	85	271	271	0.02	0.19	0.15	0.1	5061
122	S05P5155143	85	117	110	0.17	0.13	0	0.2	5068
123	S05P5131144	9	282	282	0.12	0.12	-0.17	0.06	536
124	S05A5131145	1	283	283	0.5	0.04	-0.11	0.01	35
125	S05A5131145	0	283	283	0.47	0.02	-0.14	0.01	22
126	S05A5131145	74	283	277	0.24	0.24	-0.06	0.1	4329
127	S05P5107146	85	109	111	0.31	0.21	-0.04	0.12	5026
128	S05P5135147	86	259	271	0.24	0.14	0.12	0.12	5082
129	S05P5111148	84	114	107	0.29	0.39	0.16	0.19	5041
130	S05P5127149	2	277	276	0.49	0.06	0.62	0.02	129
132	S05P5127149	86	282	286	-0.11	0.4	0.1	0.21	5099
133	S05P5099150	84	99	103	0.06	0.12	0.19	0.18	4997
134	S05P5123151	85	282	272	0.16	0.18	0.1	0.11	4996
135	S05P5095152	85	100	98	0.21	0.18	-0.08	0.12	5055
136	S05B5131153	14	284	284	0.25	0.14	-0.14	0.13	866
137	S05P5103154	85	96	104	0.01	0.22	-0.12	0.14	5024
138	S05P5115155	85	275	281	-0.06	0.29	-0.01	0.2	5045
139	S05P5091156	84	100	99	-0.11	0.15	-0.09	0.11	4988
140	S05P5119157	85	285	283	0.06	0.15	0.23	0.12	5041
141	S05P5159158	85	108	108	0.13	0.25	0.05	0.2	5050
142	S05P5175159	84	274	273	0.36	0.27	0.11	0.16	4980
143	S05P5163160	84	103	102	0.34	0.26	0.02	0.18	5023
144	S05P5183161	85	288	282	0.35	0.19	0.01	0.13	5017
				Mean	**0.21**	**0.24**	**-0.01**	**0.13**	**5042**

Swath 06

Seq	Lline	Mins	HdgSOL	HdgEOL	North Delta	Std	South Delta	Std	Samp
46	S06P5171052	87	108	104	0.03	0.15	-0.1	0.06	5216
47	S06P5195053	92	280	281	0	0.23	-0.1	0.09	5494
48	S06P5175054	88	102	98	0.17	0.14	-0.18	0.1	5303
49	S06P5199055	89	283	284	0.11	0.31	0.38	0.18	5328
50	S06P5179056	88	107	100	-0.03	0.13	0.01	0.06	5230
51	S06P5203057	88	281	287	-0.04	0.21	0.08	0.1	5281
52	S06P5183058	89	95	95	-0.38	0.24	-0.1	0.17	5286
53	S06P5163059	88	270	270	0.33	0.14	-0.23	0.07	3071
54	S06P5139060	88	113	106	0.16	0.16	-0.06	0.08	5244
55	S06P5167061	88	278	274	0.23	0.17	0.22	0.13	5309
56	S06P5135062	57	108	111	0.19	0.38	0.27	0.07	3395
57	S06P5159063	87	268	270	0.08	0.11	0.14	0.15	5208
58	S06P5143064	88	99	99	-0.24	0.3	0.09	0.15	5280
59	S06P5123065	4	269	264	0.44	0.14	0.16	0.06	235
60	S06A5123066	95	265	258	0.24	0.32	0.44	0.13	5682
61	S06P5147067	88	118	108	-0.06	0.35	0.1	0.21	5297
62	S06P5127068	95	278	284	0.14	0.14	0.09	0.12	5660
63	S06P5151069	90	95	89	0.22	0.19	0.08	0.07	5347
64	S06P5131070	90	287	280	0.59	0.13	0.1	0.07	5368
65	S06P5155071	88	108	106	0.32	0.17	0.16	0.1	5282
66	S06P5207072	92	275	282	0.43	0.23	0.15	0.08	5464
67	S06P5187073	89	102	104	0.38	0.25	0.06	0.16	5262
68	S06P5211074	97	280	292	-0.01	0.31	0.13	0.15	5747
69	S06B5123075	14	285	290	0.16	0.19	0.2	0.09	867
70	S06P5191076	90	88	94	0.35	0.26	0.31	0.07	5363
71	S06P5215077	97	289	277	0.2	0.14	-0.05	0.08	5797
				Mean	**0.15**	**0.21**	**0.09**	**0.11**	**4847**

Exhibit 4 : **USBL Calibration**

[Cal of Geco Angler April 2002.pdf]

Exhibit 5 : **Survey Definition Changes Summary**

-

Vessel : ***Geco Angler***
Client : ***STATOIL***
Job No: ***9238***
Area : ***Volve Block 5/19, Offshore Norway..***
Dates : ***13Jun2002 – 16Jul2002*** ***Seqs : 001 to 161***

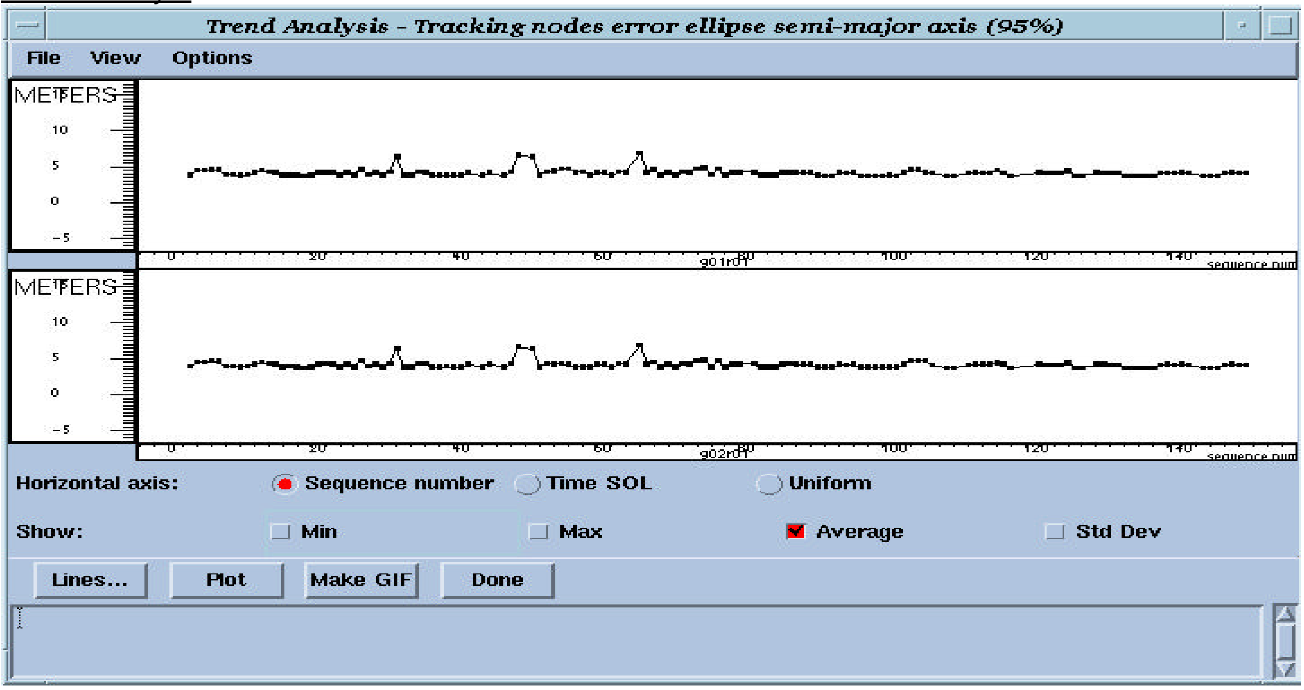
NAME	DATE	SEQ	CHANGE
9238_src01 Cable.Swath 01	*13Jun02*	*001*	*Start of Survey, 3D 4C, 6klm*
9238_rcv01 Cable.	*13Jun02*	*001*	*Start of Survey, 3D 4C, 6klm*
9238_src02	*18Jun02 entered into*	*027*	*New Velocity Profile TSDIP02 surdef..*

End of Survey….

Exhibit 6 : **Trend Analysis**

- **Tracking Node Error Ellipse Semi-major Axis (95%)**

Whole Survey…



Cross Separation (Sources)

Whole Survey

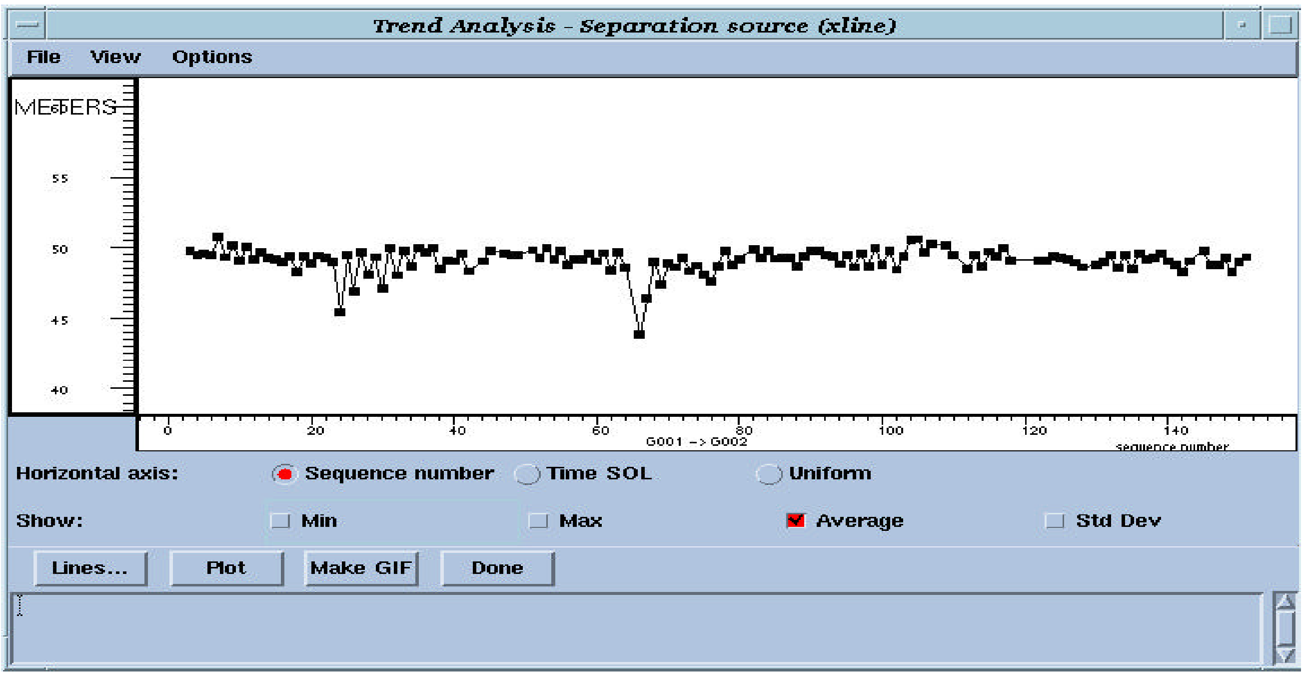
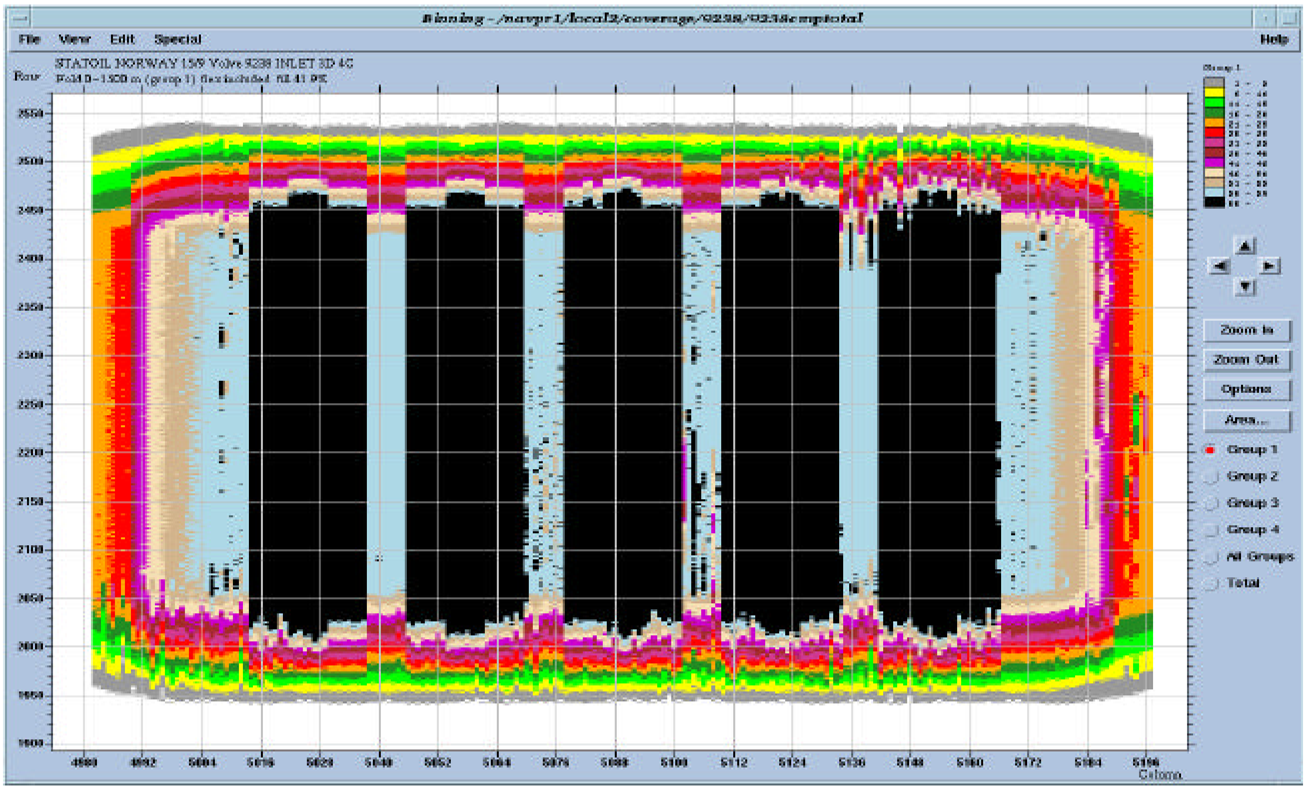
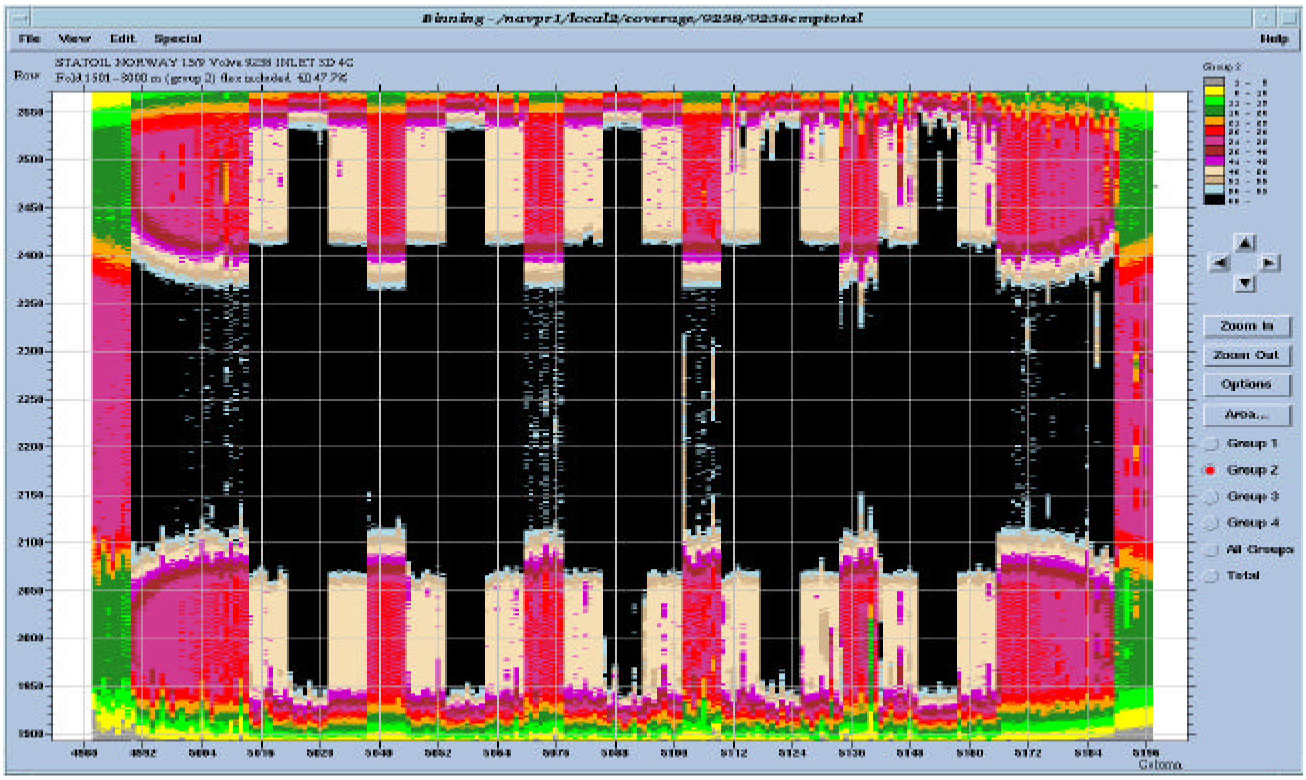


Exhibit 7 **: Coverage Plots**

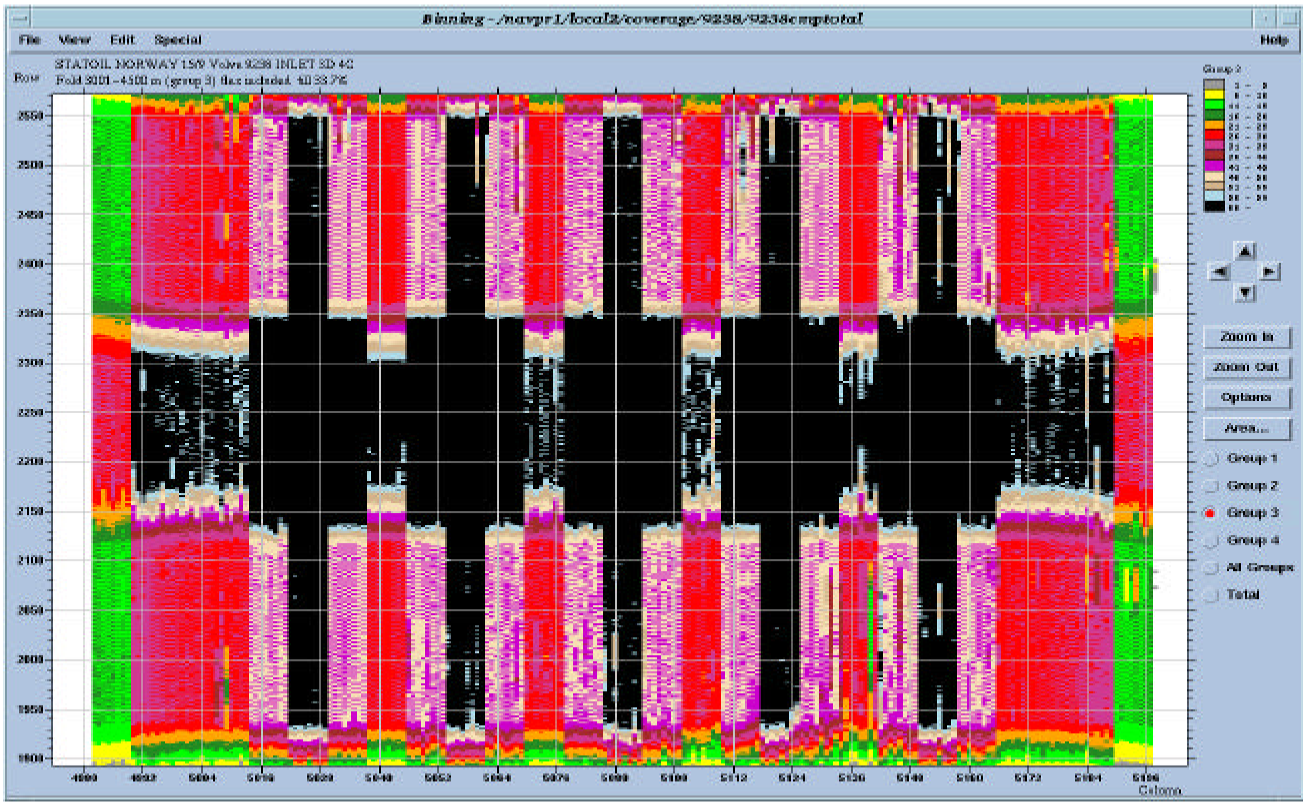
- **CMP Grp 1**



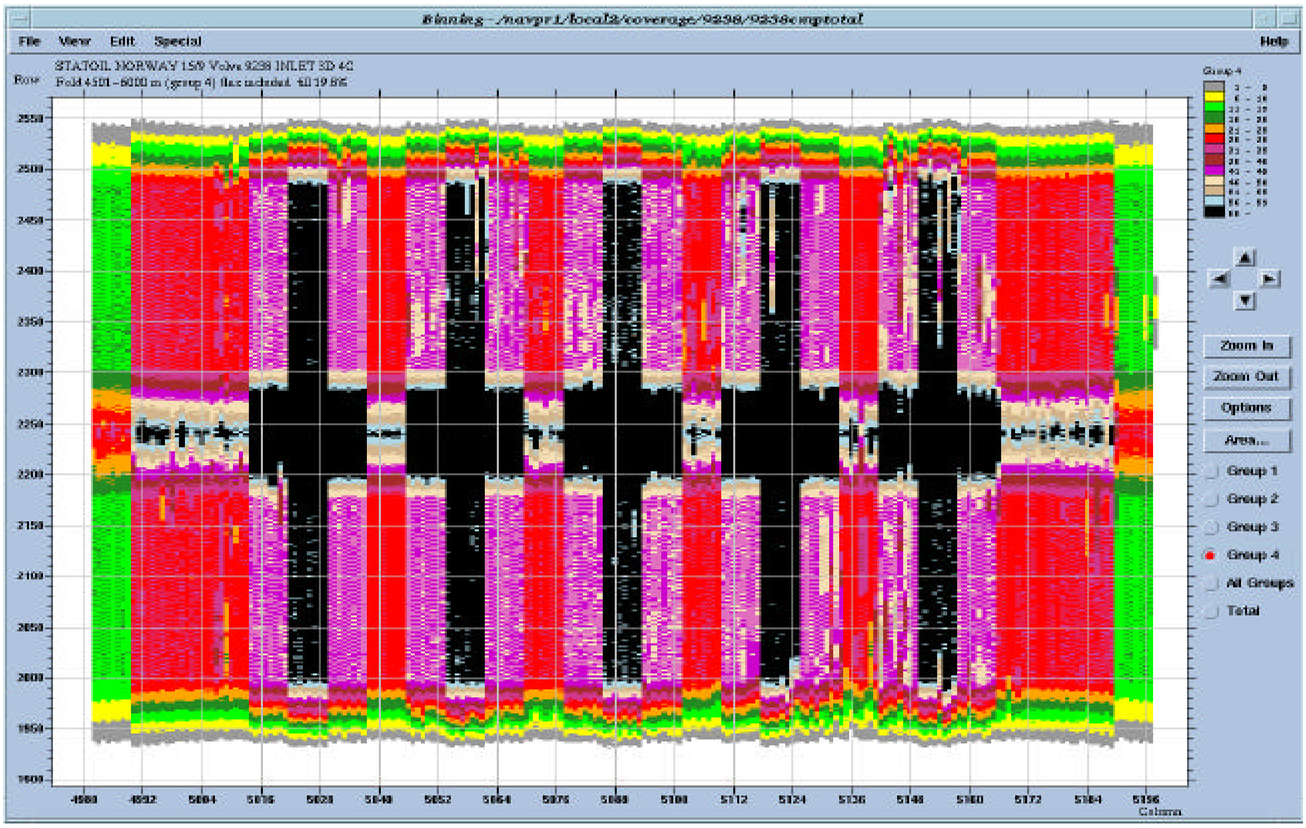
- **CMP Grp 2**



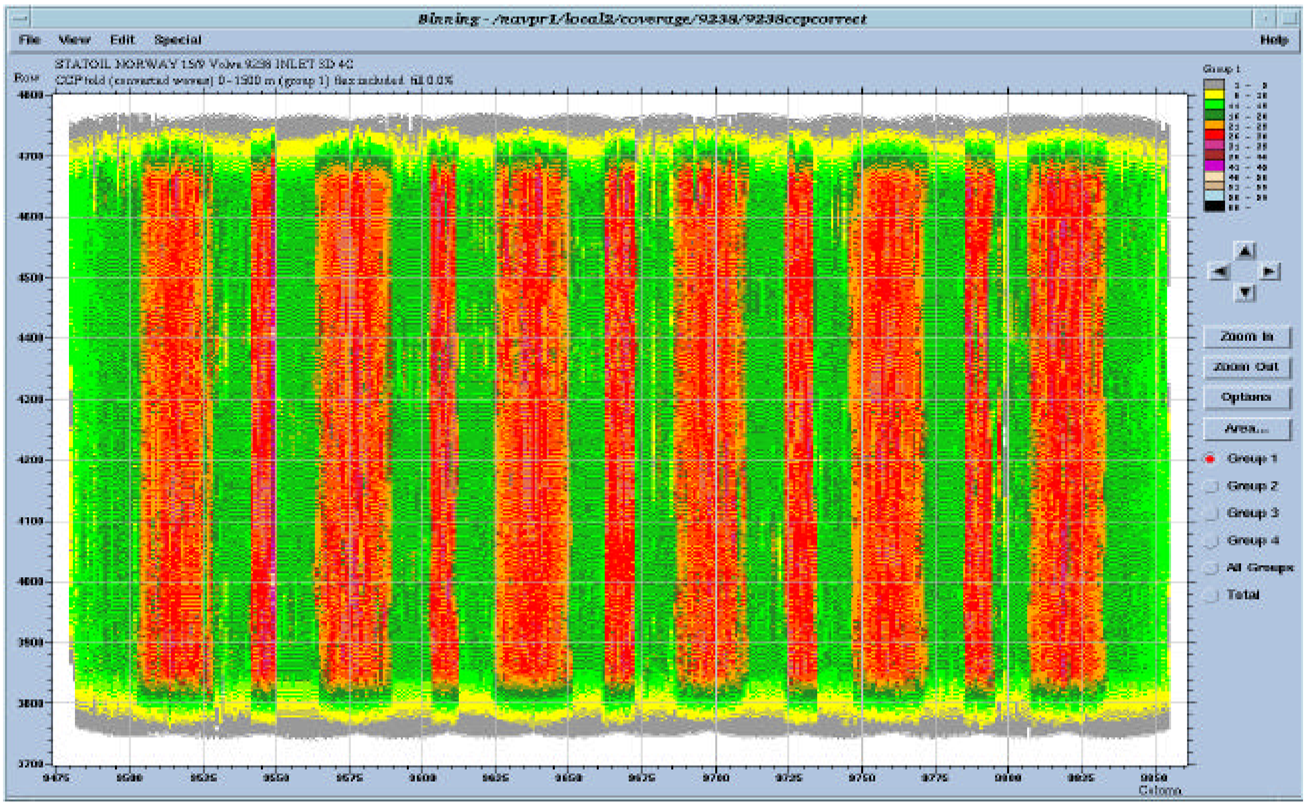
- **CMP Grp 3**



- **CMP Grp 4**

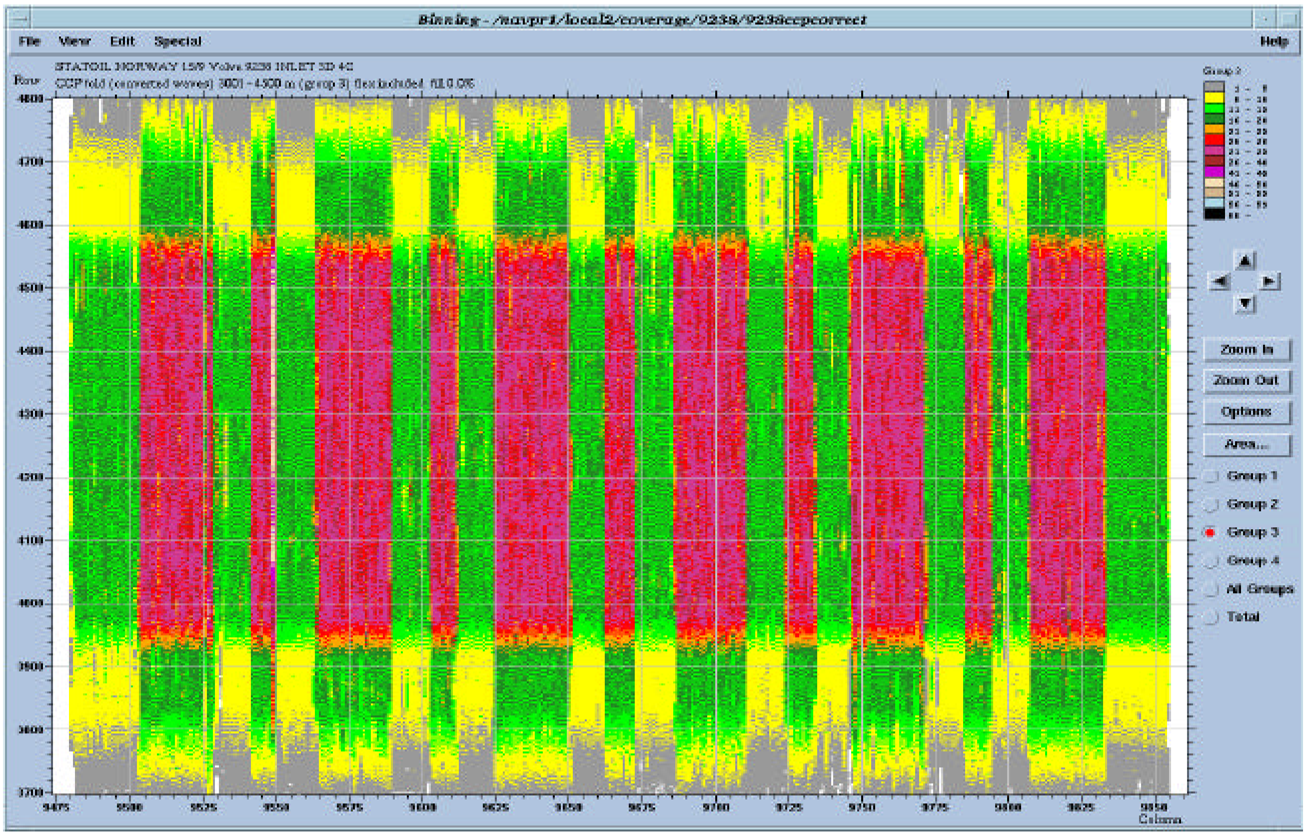


- ## CCP Grp 1

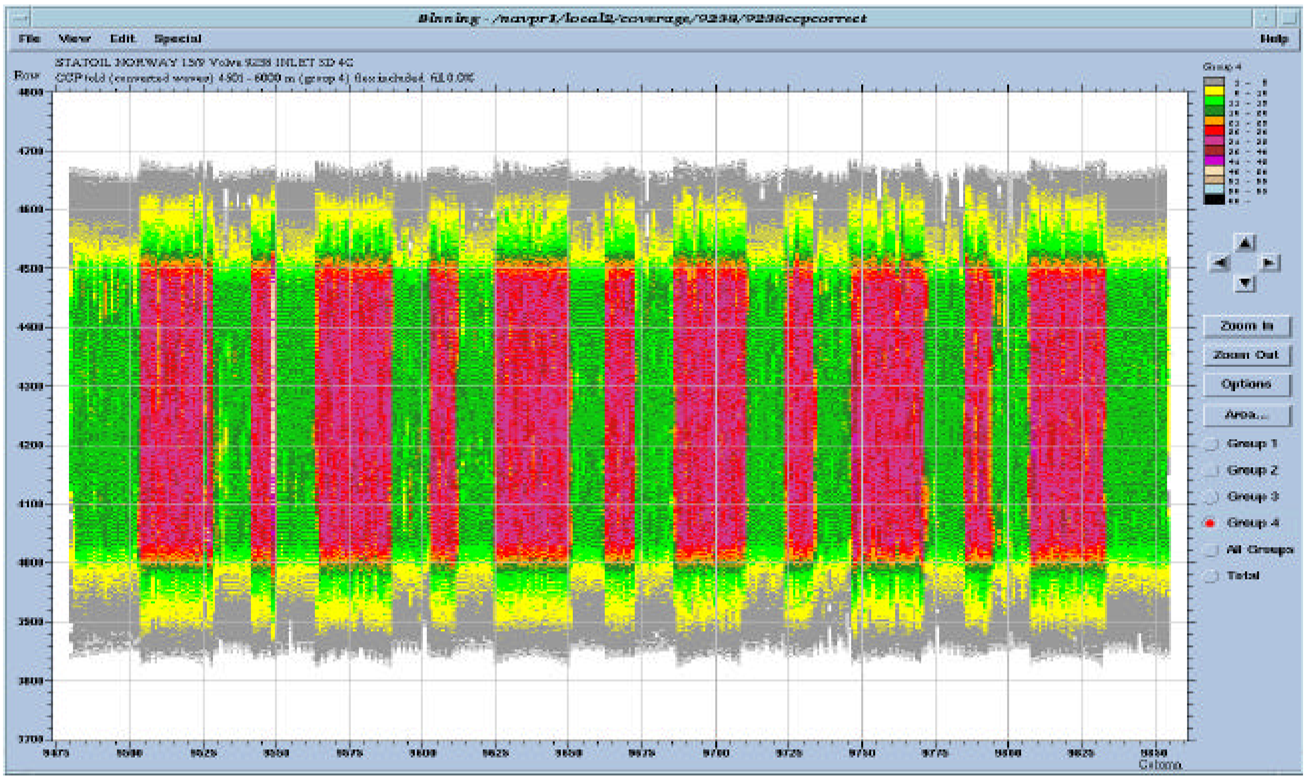


- ## CCP Grp2

❑ CCP Grp3



❑ CCP Grp 4



Instrumentation, Source and QC

21. Instrumentation and QC System Description

System	Hardware	Software
Recording	-SUN SS1000E, 5CPUs 60MHz, 1024Mb RAM -2 Streamer Interfaces -1 RC/RTV	Ver 1.6 rev 30052000
Triacq plotting	-SUN SS1000E, 8CPUs 60MHz, 640Mb RAM	
Tape drives Plotter Tape drives on Inlet	4 x IBM 3590 2 x OYO Plotter, GS 622 2x IBM 3590	D019-6F9
Onboard QC	2x Sun Ultra 2 x 200Mhz 106 Giga Bytes Disk Space (Including system disks)	SunOS 5.5.1 running on Solaris 2 Gecoseis Release 5.3 Charisma 3.8.3 Tidi Version 1.2b TheDisp Version 4.0
Source Controller SSS	Spark 2	Solaris 2.5 / OCM 1.8
Auxiliary Systems External Header	Ext.Hdr. Geco VME	Version 8.5

22. Instrumentation and QC Tests

22.1 Start-up Tests

A standard Geco Monthly test was performed before start of Sequence 1, after the cables were deployed on the seabed.

For details on the test results, see the tables below in paragraph 22.3.
For details on the test setup, see the tables below in paragraph 22.4.1.

Bad channels are logged in the header of the Observer Logs.

22.2 Additional Client Tests

22.3 Daily and Monthly Tests

The daily test will produce 11 files and the Monthly test 34 files the Extended test will produce 39 files.

Abbreviations used for test names in the test sequence tables:

- NA Noise Analysis
- PS Preamplifier Sensitivity
- PR Pulse Response
- HC Hydrophone Connection
- CF CrossFeed
- HD Harmonic Distortion
- NC Noise with Calibration line
- CS Current Setting, indicates that the current survey definition setting will be used for this parameter.

- **Daily Test**

Date	Accepted by client	Comments
17.06.02	Yes	Trace 319,467,483,563,780,795,807,917 950,1075,1122,1271,1539,1610,1735 fails HC
22.06.02	Yes	Trace 319,467,483,552,563,795,807,917 950,1075,1122,1271,1539,1735 fail HC
23.06.02	Yes	
27.06.02	Yes	Trace 319,467,483,552,563,795,807,917 950,1075,1271,1539,1610,1735 fail HC
29.06.02	Yes	Trace 180,319,467,483,563,795,807 950,1075,1122,1271,1539,1735 fail HC
02.07.02	Yes	Trace 319,461,467,483,563,795,807, 950,1075,1271,1539 fail HC
03.07.02	Yes	Trace 180,182,319,461,467,483,552,563 780,795,807,950,1075,1271,1539,1592, 1610,1735
11.07.02	Yes	Trace 319,461,467,483,563,795,807 950,1075,1271,1539,1592,1610,1735 Fail HC
12.07.02	Yes	Trace 181,182,218,319,461,467,483,552 563,795,807,917,950,1075,1271,1539 1592,1735 Fail HC

- **Extended test**

Date	NA	PS	PR	CF	HD
14.06.02	OK	OK	OK	OK	OK
15.07.02	OK	OK	OK	OK	OK

22.4 End of Job Test

A standard Geco Extended test was performed after the last sequence, before the cables were recovered.

22.4.1 Geco Monthly Test

File No.	Preamp Input state	Input Signal (dB/fs)	(Hz)	Test Name	Test type/ Parameter
1	GND	-	-	Noise Analysis	RMS Noise DC offset
2	Internal Oscillator	-1	31.25	Gain Accuracy	Accuracy
3	Internal Oscillator	0	50µs	Pulse Response	LC/HC frequency And slope
4	Internal Oscillator	0	62.50	Hydrophone Connection	Accuracy
5	Int. Osc.	-1	31.25	CrossFeed	Ch # 01 driven
6	”	”	”	”	Ch # 02 driven
7	”	”	”	”	Ch # 03 driven
8	”	”	”	”	Ch # 04 driven
9	”	”	”	”	Ch # 05 driven
10	”	”	”	”	Ch # 06 driven
11	”	”	”	”	Ch # 07 driven
12	”	”	”	”	Ch # 08 driven
13	”	”	”	”	Ch # 09 driven
14	”	”	”	”	Ch # 10 driven
15	”	”	”	”	Ch # 11 driven
16	”	”	”	”	Ch # 12 driven
17	”	”	”	”	Ch # 13 driven
18	”	”	”	”	Ch # 14 driven
19	”	”	”	”	Ch # 15 driven
20	”	”	”	”	Ch # 16 driven
21	Int. Osc.	-1	31.25	Harmonic	THD
22	”	-10	”	Distortion	”
23	”	-20	”	“	”
24	”	-30	”	“	”
25	”	-40	”	“	”
26	”	-50	”	“	”
27	”	-60	”	“	”
28	”	-1	7.81	“	”
29	”	-10	”	“	”
30	”	-20	”	“	”
31	”	-30	”	“	”
32	”	-40	”	“	”
33	”	-50	”	“	”
34	”	-60	”	“	”

22.4.2 Geco Extended Test

File No.	Preamp Input state	Input Signal (dB/fs)	(Hz)	Test Name	Test type/ Parameter
1	Internal Oscillator	-1	20.00	Preamp. Sensitivity	Accuracy
2	Internal Oscillator	-	none	Noise Analysis	RMS Noise DC offset
3	Int. Osc.	0	20.00	CrossFeed	Ch # 01 driven
4	”	”	”	”	Ch # 02 driven
5	”	”	”	”	Ch # 03 driven
6	”	”	”	”	Ch # 04 driven
7	”	”	”	”	Ch # 05 driven
8	”	”	”	”	Ch # 06 driven
9	”	”	”	”	Ch # 07 driven
10	”	”	”	”	Ch # 08 driven
11	”	”	”	”	Ch # 09 driven
12	”	”	”	”	Ch # 10 driven
13	”	”	”	”	Ch # 11 driven
14	”	”	”	”	Ch # 12 driven
15	”	”	”	”	Ch # 13 driven
16	”	”	”	”	Ch # 14 driven
17	”	”	”	”	Ch # 15 driven
18	”	”	”	”	Ch # 16 driven
19	Internal Oscillator	-5	1.5ms	Pulse Response	LC/HC frequency And slope
20	Int. Osc.	-1	7.81	Harmonic	THD
21	”	-10	”	Distortion	”
22	”	-20	”	“	”
23	”	-30	”	“	”
24	”	-40	”	“	”
25	”	-50	”	“	”
26	”	-60	”	“	”
27	”	-1	31.25	“	”
28	”	-10	”	“	”
29	”	-20	”	“	”
30	”	-30	”	“	”
31	”	-40	”	“	”
32	”	-50	”	“	”
33	”	-60	”	“	”
34	Int/Hyd/Pos	-3	7.81	Hydrophone Connection	Accuracy
35	Int/Hyd/Neg	“	7.81	Hydrophone Connection	Accuracy
36	Int/Hyd/Pos	“	31.25	Hydrophone Connection	Accuracy
37	Int/Hyd/Neg	“	31.25	Hydrophone Connection	Accuracy
38	Int/Hyd/No Pol	“	7.81	Hydrophone Connection	Accuracy
39	Int/Hyd/No Pol	“	31.25	Hydrophone Connection	Accuracy

The Table above summarises the test sequences. Below is a brief description of each test sequence.

For all tests where a test signal is applied, the signal amplitude is related in decibels (dB) to full scale (FS) of the preamplifier input.

Noise Analysis (NA)
The purpose is to find the electronic noise and DC-offset of the complete input chain, from the input of the pre-amplifier through the Delta-Sigma modulator.

All the hydrophone inputs are disconnected and no test signal is applied. The DC-offset and noise RMS values are calculated. DC-offset is removed before the noise RMS value is calculated. The offset is digitally derived and should be similar on all channels. The value is dependent on the filter settings and may be positive or negative.

Pre-amp Sensitivity (PS)
This is used to verify the pre-amplifier gain accuracy for one specific pre-amp gain-step.

A signal of known characteristics is applied to the input of the pre-amp from the internal test oscillator, and the output is compared with a predefined/calculated levels. The difference should be as small as possible.

The mean value of the accuracy measurements for all channels is also calculated. This value represents the systematic error in the chain, normally caused by inaccuracy of the oscillator output. This is also displayed alongside the accuracy results.

Pulse Response (PR)
The purpose here is to find the low- and high-cut frequencies and the slopes for all channels in the system.

A pulse from the internal test oscillator, with known characteristics, is applied to the input of the pre-amp. The output is used to perform a 2048 sample FFT of all channels, which gives a 1024 point frequency spectrum of the input signal for every channel.

The cut-off frequencies and slopes are calculated for both low-cut and high-cut filters based on interpolation of FFT spectrum data. The cut-off frequency is defined as the –3dB point for both the low- and high-cut filters. Zero dB is the pass-band amplitude.

Hydrophone Connection (HC)
This test will measure the impedance of a hydrophone group at the test frequency. Each Hydrophone group is put in parallel with the internal test signal generator output and a strong differential signal applied to all channels.

The RMS values for each channel are calculated and deviations from median, mean or a fixed reference specified by the user will be calculated.

We normally run this test set to MEDIAN as the default.

Crossfeed (CF)
This is to check the Crossfeed isolation between channels in the bubbles.

A test signal from the internal oscillator is applied to only one channel at a time in every bubble. This requires 16 files to be run to calculate Crossfeed for all channels. RMS and DC-offset values are calculated. The DC-offset is subtracted from the signal amplitude before the RMS value is calculated.

15 Crossfeed values for each channel will be calculated. The **worst case** Crossfeed amongst the 15 will be taken as the final result.

Harmonic Distortion (HD)
This test is used to check the linearity of the input chain, by finding the total harmonic distortion of the signal chain, from the internal test signal generator input, to the digitized data format.

A sine wave with known level and frequency is applied from the internal test signal generator to the input of the pre-amplifier. The distortion of this known input signal is calculated on the basis of the condition of the signal at the recording end of the signal chain.
The test follows the following steps:

1. RMS values and DC-offsets are calculated.
2. A 2048 sample FFT of all channels is performed. This gives a 1024 point frequency spectrum of the input signal for every channel.
3. The main component in the frequency spectrum is found and the corresponding frequency.
4. Then the first 4 over-harmonics, or over-harmonics up to the Nyquist frequency or high-cut frequency, whichever is lower, together with the corresponding levels.
5. Then the Total Harmonic Distortion (THD) in dB, is calculated, compared to the level of the fundamental frequency component.

23. QC Products and Processing Sequence

This was a 3D inline survey, composed of 6 swaths, each with 24 source lines. There were two receiver cables, each 6km long. The cable configuration was as follows:

CHANNELS	CABLE 1	CABLE 2
P	5-244	981-1220
X	249-488	1225-1464
Y	493-732	1469-1708
Z	737-976	1713-1952

Source lines were shot parallel to the cables. For a detailed list of survey parameters, see chapter **24.3 Instrument Summary**.

23.1 Online Brute Stack

Brute stacks were made for the P-, X-, Y and Z-components for all sequences. Paper plots of the raw stacks were produced during each swath for each source line above the cables and for each of the outermost lines. Gifs of the stacks were produced for every sequence, for publication on supervision.

- **Processing sequence:**

Input cmp/ccp line :	all channels per component.
Anti alias filter	Minimum Phase Butterworth filter 90 Hz(72dB/Oct) applied to P and Z 70 Hz(72dB/Oct) applied to X and Y
Data reduction	Temporal resample to 4 ms
Geometry definition	CCP=(Source+(Vp/Vs)*Receiver)/(1+Vp/Vs) Vp/Vs = 1 for P and Z components Vp/Vs = 2.8 for X and Y components
Polarity reversal (X component only)	Reverse polarity of positive offset inline data.
Static correction for recording filter delay	-48.07 ms
Spherical divergence correction	Amplitude * t** 2.2 applied 0 - 10000 ms.
Predictive deconvolution	See below
Normal moveout correction	Velocity function, see below.
Pre-stack front mute, offset/time pairs:	P and Z components: 300+0, 2500+3000, 4500+10000 taper 40 X and Y components: 170+0, 1900+3000, 4300+10000 taper 40
Pre-stack tail mute, offset/time pairs:	P and Z components: 0+0, 300+3000, 890+10000 taper 24 X and Y components: 0+2000, 450+5000, 750+10000 taper 24
Stack, square root of fold scaling	P and Z comp.: 120 nominal fold X and Y comp.: 228 nominal fold
Static correction for average water depth (receivers) and gun depth	1000 x water depth / water velocity water velocity = 1490m/s water depth between 80 and 90m.
Output :	To disk file
Data independent scaling	
Display of all component stacks	Scale 1:25,000 4.0 cm/s.

Deconvolution before stack P and Z components:

Zone 1:	Operator length	240 ms
	Gap	32 ms
	Design window 0m	500-3500 ms
	Design window 4000m	4000-7000 ms
	Apply window	0 - 10000 ms
	Prewhitening	1.0%

Deconvolution before stack X and Y components:

Zone 1:	Operator length	240 ms
	Gap	44 ms
	Design window 0m	500-3500 ms
	Design window 4000m	4500-7500 ms
	Apply window	0 - 10000 ms
	Prewhitening	1.0%

Velocities:

A single velocity function was picked onboard using data from the first line close to or above a seabed cable. This function was applied to all successive lines as a global velocity.

PZ velocity function:

Time	Vel	Time	Vel	Time	Vel	Time	Vel	Time	Vel
4	1477	200	1480	560	1495	848	1510	1116	1549
1796	1674	2144	1773	2844	1967	4224	2314	6120	2770
7924	3118	10000	3550						

XY velocity function

Time	Vel	Time	Vel	Time	Vel	Time	Vel	Time	Vel
4	1480	208	1477	527	1256	772	1185	988	1167
1392	1205	1716	1247	1864	1256	2284	1302	2952	1410
3704	1532	4476	1646	4952	1722	6496	1920	7996	2093
10000	2300								

For each sail line the closest streamer was used to generate a brute stack for one subsurface cmp line. Paper plots of the stacks were produced at the end of each line.

23.2 Shots and FK Spectral Analysis

Every 41st P-component shot was chosen and displayed in the FK domain. This helped to identify noise sources and QC data outside the windows used for Attributes analysis.
The analysis was performed in the window 7000-10000ms, 500ms ramp on/off.

- **Processing sequence:**

Data Input:	Every 41st shot, all P component channels from a particular cable.
Anti alias filter	Minimum phase, Butterworth lowpass 90Hz(72dB/Oct)
Data reduction	temporal to 4ms sample rate
Scaling	Amplitude * t**2.0 applied 0 - 10000 ms.
Output	To disk file.
Spectral analysis	Performed in the FK domain. Window 7000 - 10000ms. 500ms ramp on/off
Output:	To disk file.
Online display:	Using theDisp package.

23.3 RMS Online Analysis

23.3.1 Deep RMS window

RMS values from the last 500 ms of the record were calculated for every trace, each shot. These values were displayed on-line for identification of noise sources and noisy traces. Average RMS values for each component over each shot were calculated.

- **Processing sequence:**

1. Data Input:	All shots, channels and components, window 9500-10000 ms at sample rate 4 ms.
2. Scaling:	By 1000 to convert amplitudes to microbars and micro-meters/second.
3. RMS analysis:	One trace is output for each shot containing the RMS amplitude over the window for each channel. An average, maximum, minimum and standard deviation RMS value for each component on each cable is also calculated; the values are appended to each trace.
4. Output:	To disk file.
5. Online display:	Using InDA and Tidi display package.

The RMS values for each channel in addition to the mean, the maximum and the standard deviation RMS amplitudes vs. shot point were published in supervision on the web.

23.3.2 Full data RMS analysis

RMS values from the entire record length were calculated for every trace, each shot. These values were displayed on-line to give an overall impression of the recorded data. Any severe noise events such as autofires, misfires and electronic parity errors could be identified.

- **Processing sequence:**

1. Data Input:	All shots, all channels, all components, entire record length.
2. Scaling:	By 1000 to convert amplitudes to microbars and micro-meters/second.
3. RMS analysis:	One trace is output for each shot containing the RMS amplitude over the window for each channel. An average, maximum, minimum and standard deviation RMS value for each component on each cable is also calculated; the values are appended to each trace.
5.Output:	To disk file.
6.Online display:	Using InDA and Tidi display package.

The RMS values for each channel in addition to the mean, the maximum and the standard deviation RMS amplitudes vs. shot point were published in supervision on the web.

23.3.3. Frequency RMS analysis

Filtered mean RMS values from a 8750-9750 ms deep window were calculated for every trace, every component for each shot and for a defined cable. Filtered shot vs. trace RMS values were produced by applying different band pass filters prior to the RMS calculation. These values were displayed online for identification of the frequency content of external noise sources.

- **Processing sequence:**

1. Data Input:	All shots, all components, window 8750-9750 ms.
2. Anti alias filter	Minimum phase, Butterworth lowpass 90Hz(72dB/Oct)
3. Data reduction	Temporal resample to 4 ms.
4. Scaling:	By 1000 to convert amplitudes to microbars and micro-meters/second.
5. Bandpass filters	<10 Hz, 10 - 20Hz, 20 - 40Hz, 40 - 60Hz, 60 Hz – anti alias filt.
6. RMS analysis:	One trace is output for each shot containing the RMS amplitude over the window 6750 - 7750 ms for each channel. An average RMS value for each component on each cable for the whole shot is also calculated, the value is appended to each trace.
7. Output:	To disk file.
8. Online display:	Using Tidi display package.

The RMS values for the mean, the maximum and the standard deviation RMS amplitudes vs. shot point were published in supervision on the web.

23.4 Shot Displays

While working online, every channel for each shot was output to disc. This enabled individual online shot analysis of any identified noise sources.

- **Processing sequence:**

1.	Data Input:	Each channel, each shot resampled to 4 ms. (Anti alias filter applied 90Hz, 72dB per octave)
2.	Scaling	t**2.0, applied 0 - 10000 ms.
3.	Scaling	P component scaled by 2.0 X and Y components scaled by 20.0 Z component scaled by 70.0
4.	Output:	To disk file.
5.	Online display:	Using theDisp display package.

23.5 Navigation QC

For each inline, cable and source positions were QC'd by applying linear move out, LMO, on common shot gathers, CSG, and common receiver gathers, CRG. A flat and continuous LMO corrected water bottom direct arrival indicates a high level of accuracy in the navigational positioning data. To date these procedures have shown to be a highly accurate QC method.

- **Processing sequence:**

1.	1. Collect P component data for CSG and CRG online.	All shots into selected receivers for the common receiver gathers. All receivers into selected shots for the common source gathers.
2.	Anti alias filter	Minimum phase, Butterworth lowpass 90Hz(72dB/Oct)
3.	Data reduction	Temporal resample to 4 ms.
4.	Spherical divergence correction.	Time**2.2, applied 0 - 4000 ms
5.	Merge seismic and navigation	Coordinates and water depth
6.	Correct range to source-receiver distance	
7.	Static shift	+1000 ms
8.	Apply LMO	Water velocity
9.	Display	

In addition to this, water depth measurements were displayed graphically for all sources and receivers, as a check for erroneous values.

24. Data Quality / Observations

24.1 Quality Control Summary

The RMS values are displayed in real time as shot vs. trace (SVT) plots. The RMS analysis, when used in conjunction with the online shot records, frequency analysis, fk analysis and the brute stacks, allows a rapid assessment of the noise types and their associated effects on data quality.

Using seabed cables avoids the problem of swell noise associated with normal towed streamer work. However occasional ‘spiking’ or pulsing on geophone channels can arise due to coupling effects, tides, and sea bottom current changes. This effect is removed by normal channel editing routines. It should be noted that coupling effects can lead to particular channel locations looking noisy or bad. Generally this can be seen mainly on the Y- and Z-components. This can be caused by the cables being laid over undulating areas or where there is outcropping of material on the seabed.

Average background RMS noise levels for the survey were:

p (ub)	*x (um/s)*	*y (um/s)*	*z (um/s)*
9.86	**0.41**	**0.34**	**0.16**

There was fluctuation around these values from sequence to sequence due to the external noise sources encountered during acquisition, such as seismic interference and ship noise, although deviations from the values shown above were generally very small as a result of low levels of external noise throughout the survey. Sequences considered to be strongly affected were analysed by the onboard client. Re-shoots were done when required, although this was necessary on very few occasions.

Examples of encountered noise can be seen on the supervision website.

24.1.1 Noise Types Encountered

- **Ship noise**

  This was a major noise source encountered on many sequences due to the proximity of rigs and supply vessels in the area. Noise ranged from slight to up to 20µB above background.

- **Seismic interference**

  Seismic interference was present at low levels on sequences 031, 033 due to the Atlantic Explorer shooting in a nearby sector. For a few sequences the noise reached 6 to 7µB. For two sequences the noise reached 12 and 20 µB for some shots, and was seen to affect mainly the P component.

- **Coupling**

  Coupling problems usually occur when cables are laid over hard materials such as stones and pipelines, or where the seabed is particularly irregular. Quite strong geophone spiking was observed frequently during this survey – mainly affecting the Y & Z components.

- **Thruster/Propeller noise**

  Thruster noise produced by the dynamic positioning of the recording vessel was not significant.
  The propeller noise from the source vessel, Western Inlet, affected the near offset traces. Levels were within normal expectations.

- **Other**

  Due to some constructions in the area, reflections and diffractions were visible on shot records.

24.2 Swath Noise Summaries

The Swaths for the survey were shot in the following order:
4, 1, 6, 3, 2, 5.

SWATH SUMMARY

Swath: 01 Sequences: 001 to 026

General location

Swath 1 was made of 24 shooting lines (4963- 5055 incrementing by 4) and 2 receiver lines (Figure 1).

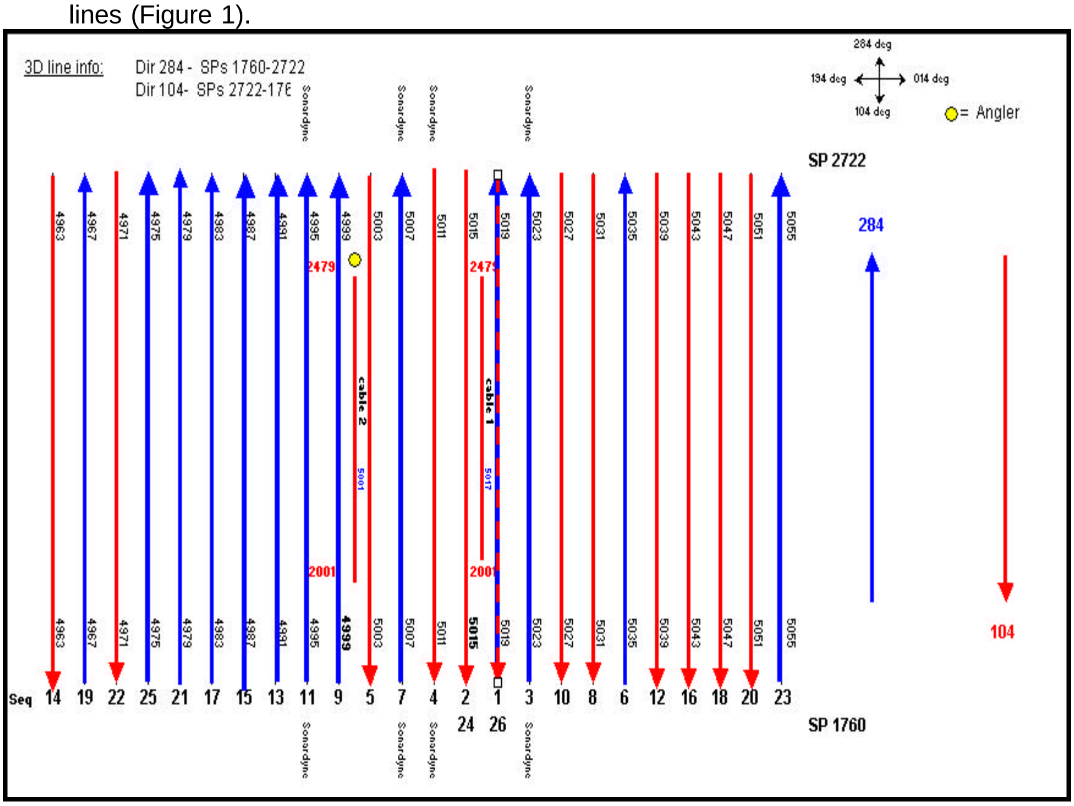


Figure 1: Swath plan

A rig complex was situated on the south of the survey area (Figure 2).

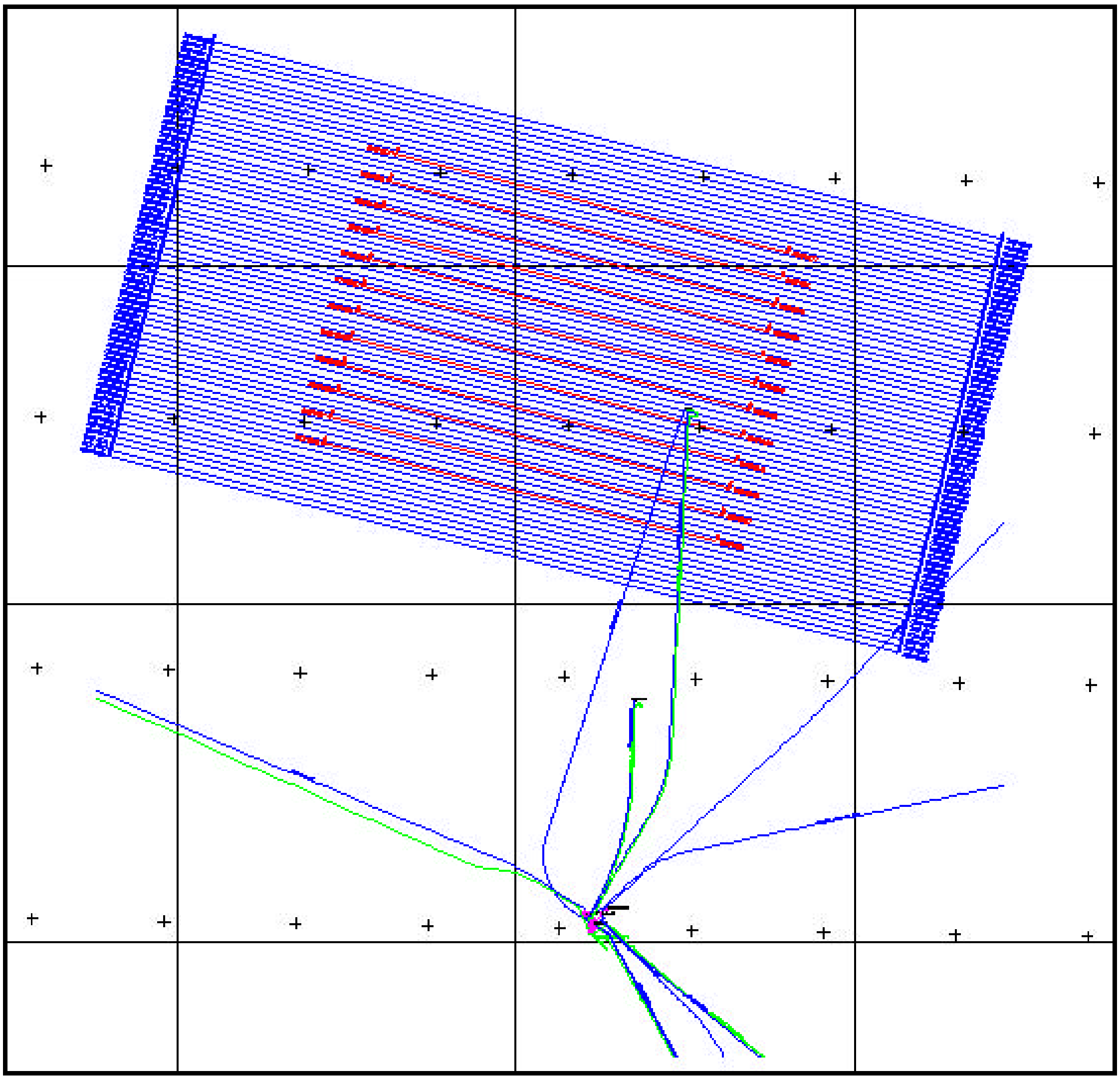


Figure 2: Rig complex location

At the time that swath 01 was shot, 2 other seismic surveys were being shot, one to the north and one to the south-west of us (see Figure 3).

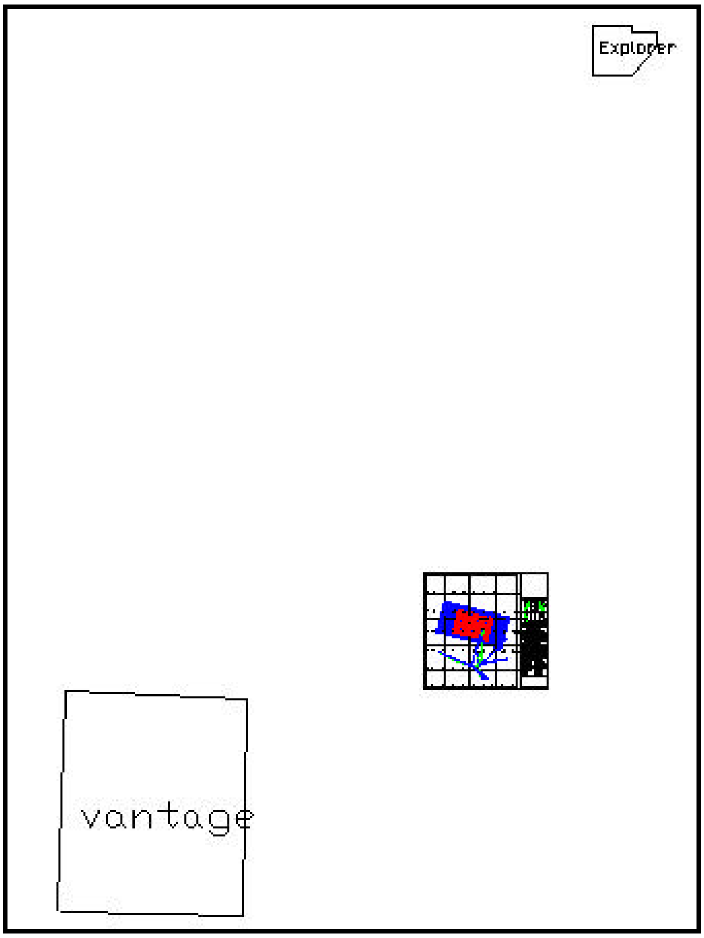


Figure 3: Seismic surveys locations

Noise description

The main sources of noise observed this swath were ship noise and seismic interference from the Veritas Vantage to the southwest UK Sector Quad 15, and from PGS to the north.

- Seismic interference

The seismic interference from Veritas was the most significant seismic interference causing the reshooting of Sequence 001 and 002. From Sequence 003 onwards we were time sharing with Veritas.

- Ship noise

Supply boats were the main source of ship noise this swath. None of the sequences contained ship noise that was very strong.

- Thruster noise

Occasionally, when the sea conditions were deteriorating (Seq.0015 and Seq. 016), some thruster noise from Geco-Angler was noticeable on the RMS plots as shown on figure 4.

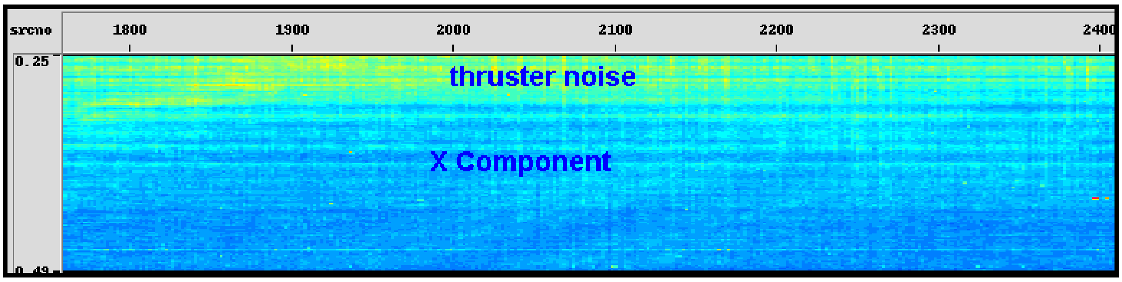


Figure 4: Thruster noise as seen on the RMS versus Shot point plot

This kind of noise is strongest on the X component and is only noticeable on the first quarter of the cable length.

- Diffractions:

The main type of diffractions we were getting was coming from seabed installations (pipes and well head structure) located in the southeastern region of the survey area (Figure 5).

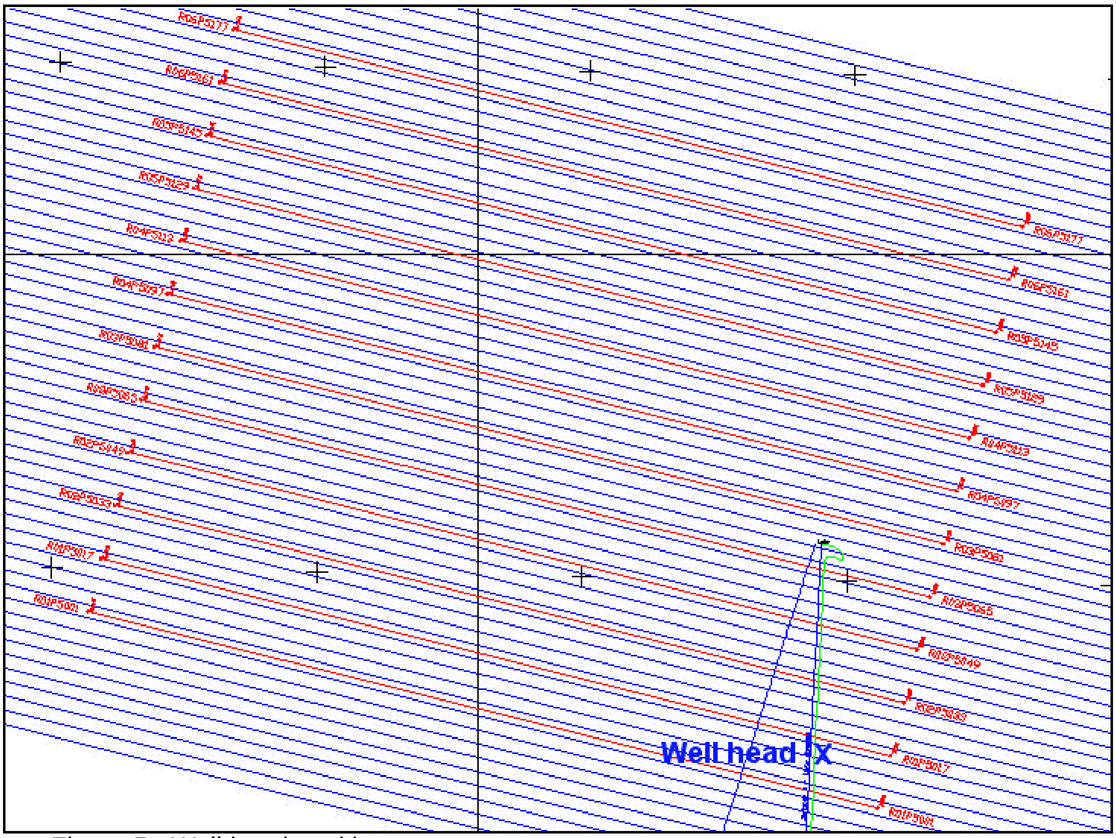


Figure 5 : Well head position

These diffractions were present on 12 lines. They were affecting the last 3 seconds of P,X,Y or Z (depending on the shooting line- Figure 6 and 7).

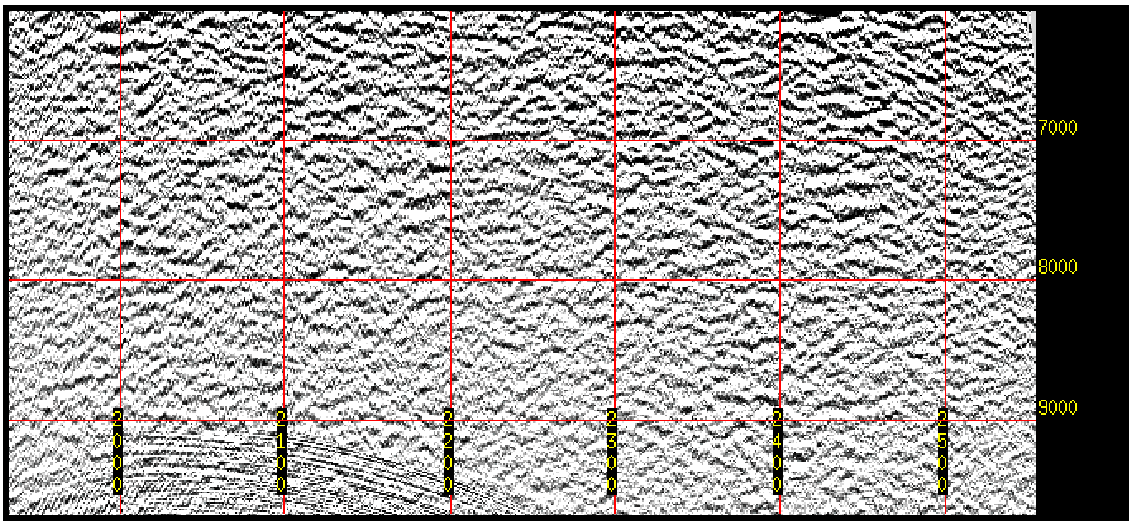


Figure 6: Diffraction on the P stack

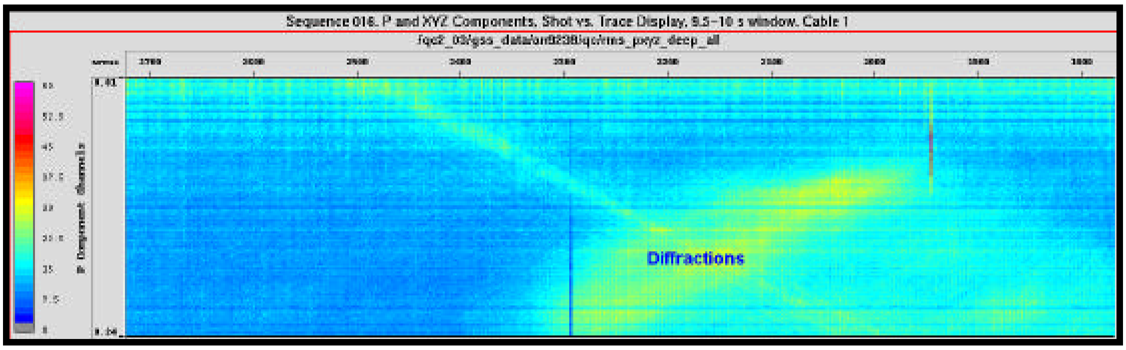


Figure 7: Diffraction as showing on the P RMS_SVT values versus Shot points

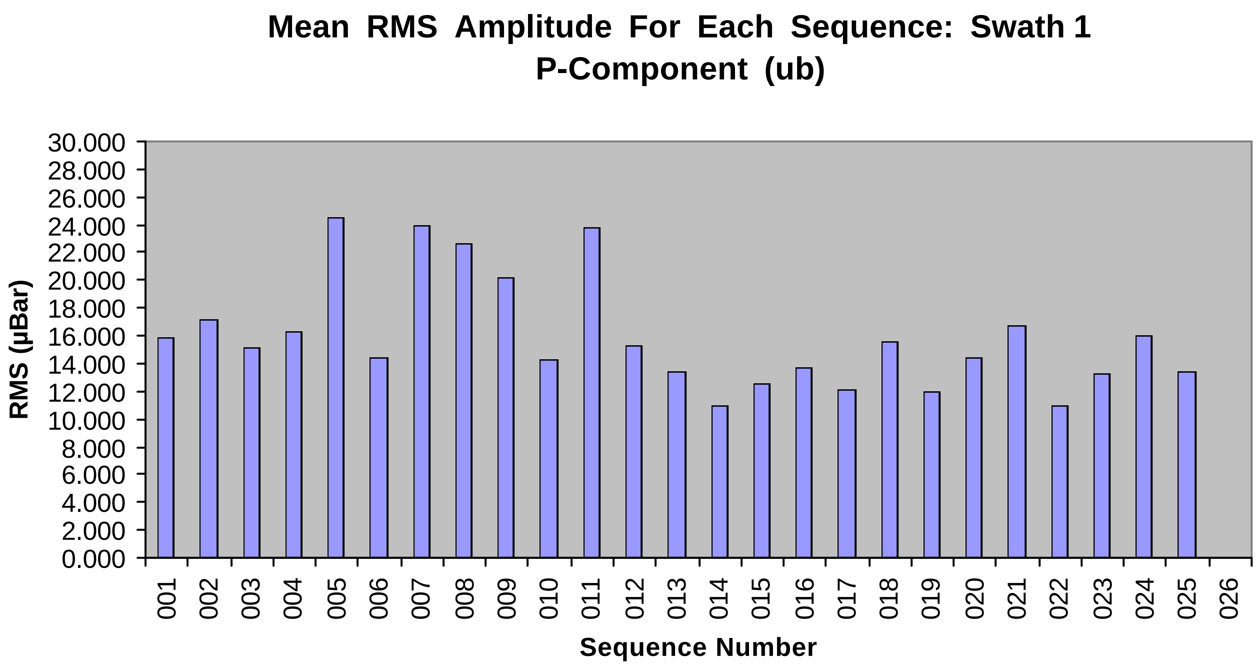
Re-shoots

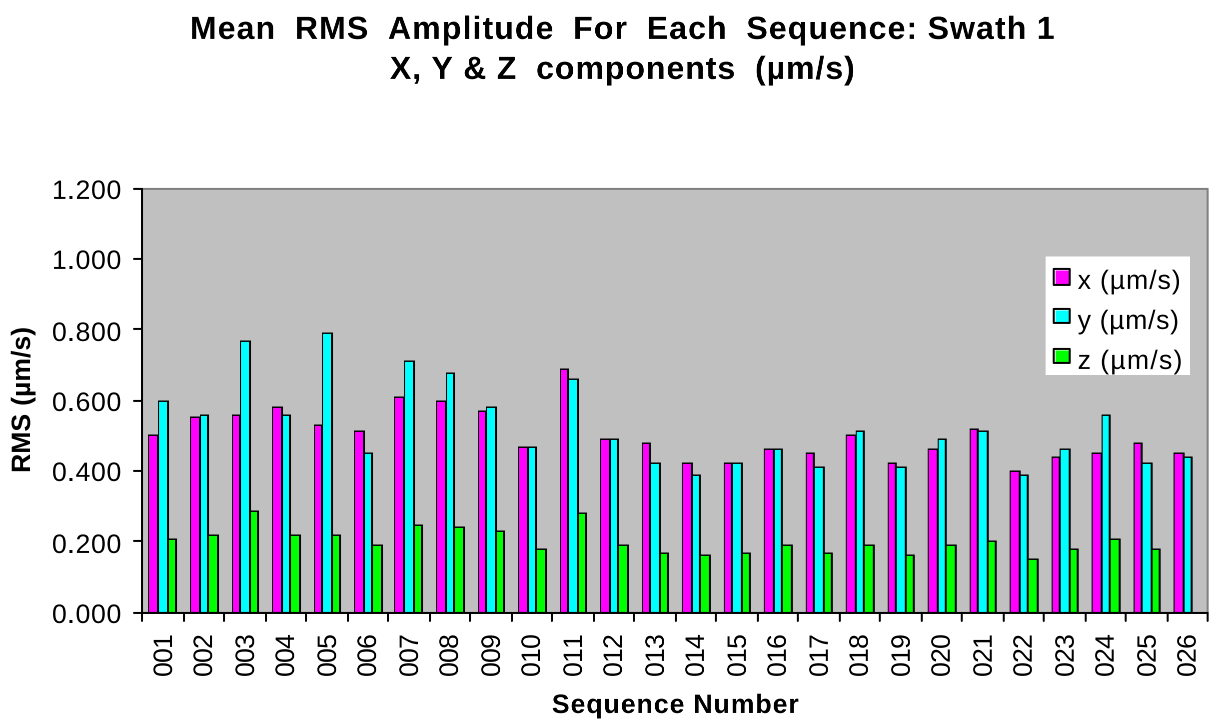
Sequence 001 and 002 were re-shot due to seismic interference from the Veritas Vantage.

Noise statistics

Average RMS noise levels for the whole swath were:

***p* (μb)**	***x* (μm/s)**	***y* (μm/s)**	***z* (μm/s)**
15.341	0.500	0.523	0.194


Mean RMS Amplitude For Each Sequence: Swath 1
P-Component (ub)
RMS (µBar)
30.000
28.000
26.000
24.000
22.000
20.000
18.000
16.000
14.000
12.000
10.000
8.000
6.000
4.000
2.000
0.000
001 002 003 004 005 006 007 008 009 010 011 012 013 014 015 016 017 018 019 020 021 022 023 024 025 026
Sequence Number


Mean RMS Amplitude For Each Sequence: Swath 1
X, Y & Z components (µm/s)
RMS (µm/s)
1.200
1.000
0.800
0.600
0.400
0.200
0.000
x (µm/s)
y (µm/s)
z (µm/s)
001 002 003 004 005 006 007 008 009 010 011 012 013 014 015 016 017 018 019 020 021 022 023 024 025 026
Sequence Number

SWATH SUMMARY

Swath: 02 Sequences: 104 to 135

General location

Swath 2 was made of 24 shooting lines (4995 - 5087 incrementing by 4) and two receiver lines; cable 1: 5049, cable 2: 5033 (Figure 1).

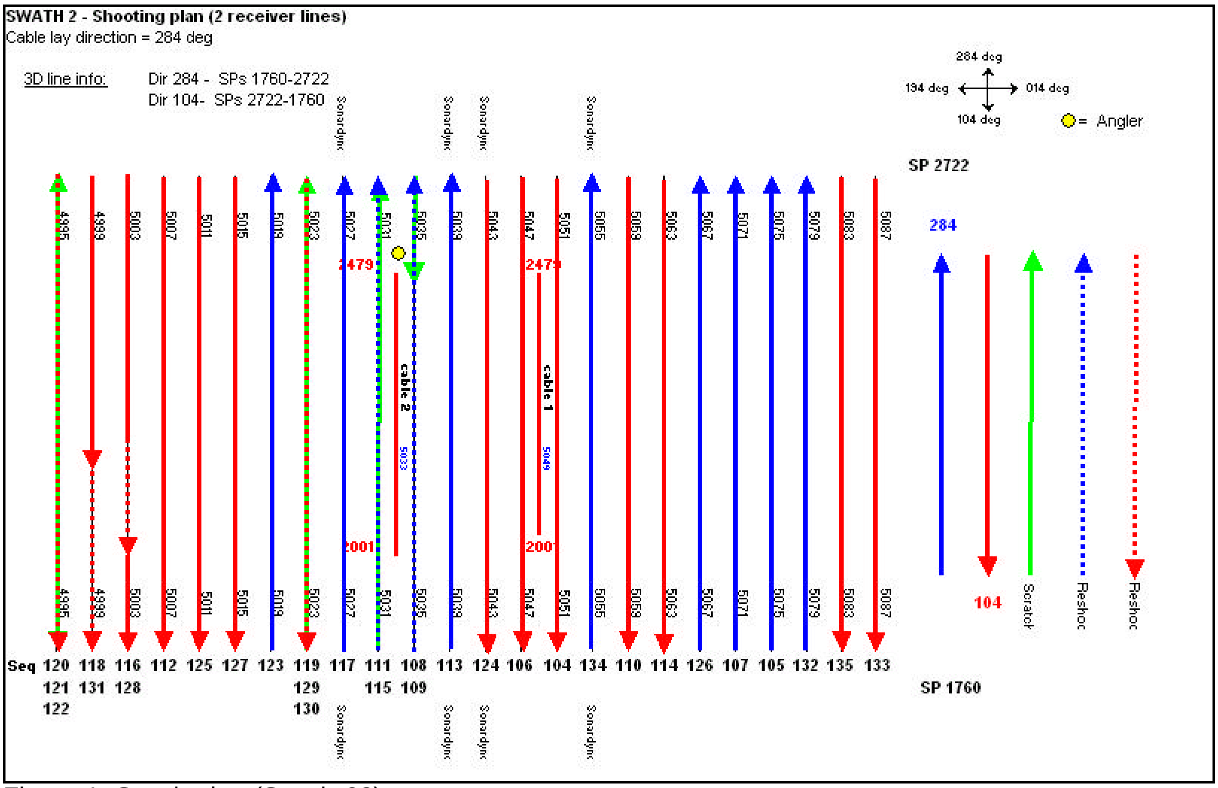


Figure 1: Swath plan (Swath 02).

A rig complex was situated on the south of the survey area (Figure 2).

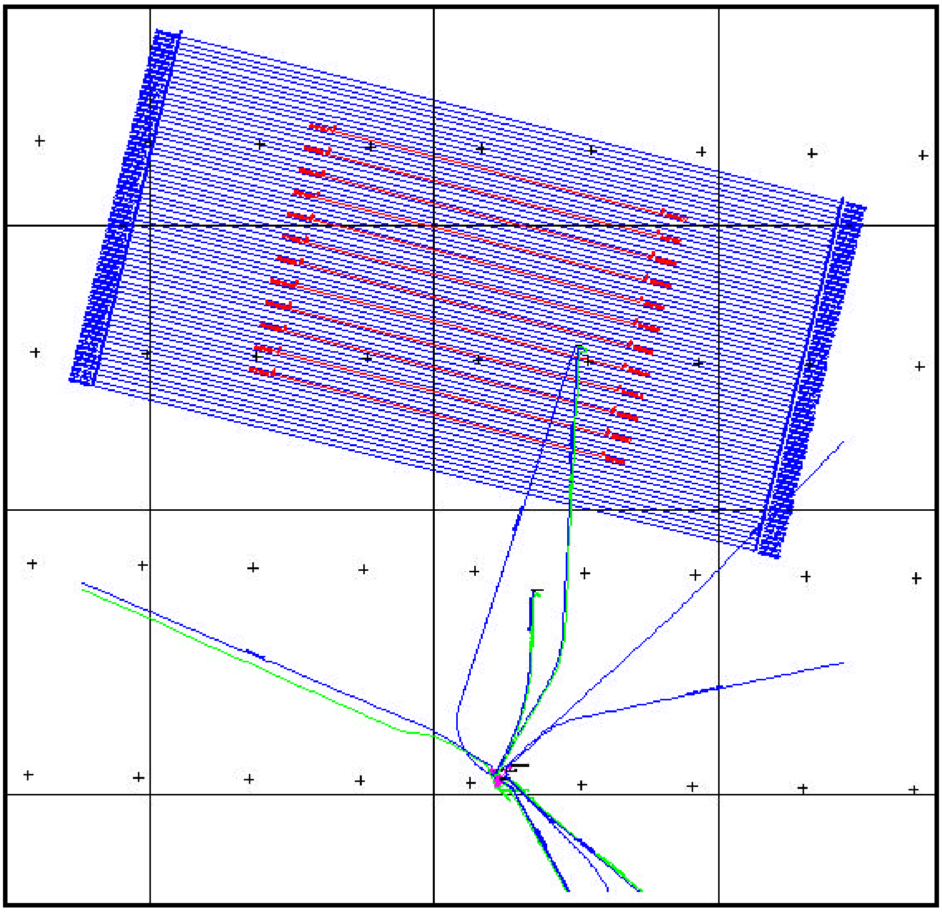


Figure 2: Rig complex location

During swath 02 we were time-sharing with the Veritas Vantage to the southwest in UK Sector Quad 15 (see Figure 3).

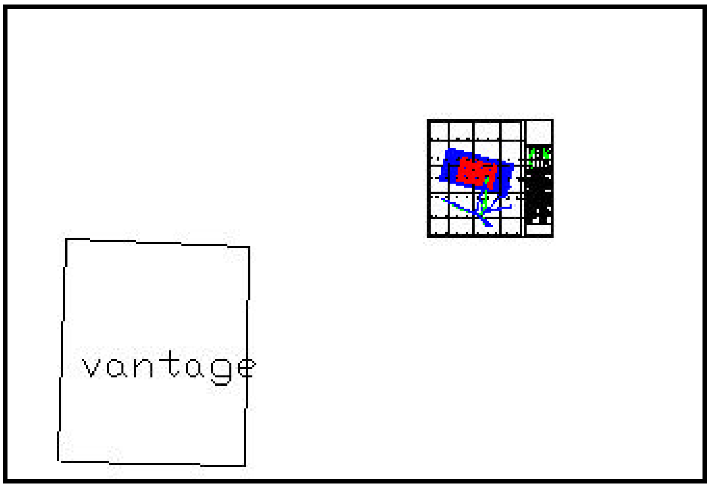


Figure 3: Seismic survey locations

<u>Noise description</u>

The most significant source of noise observed this swath was ship noise, resulting in six lines being reshot. Some weak seismic interference was also noted. Both cables were laid over a pipeline producing variable amounts of noise on the geophone channels. Diffractions were seen at late time on most of the sequences (Figure 4).

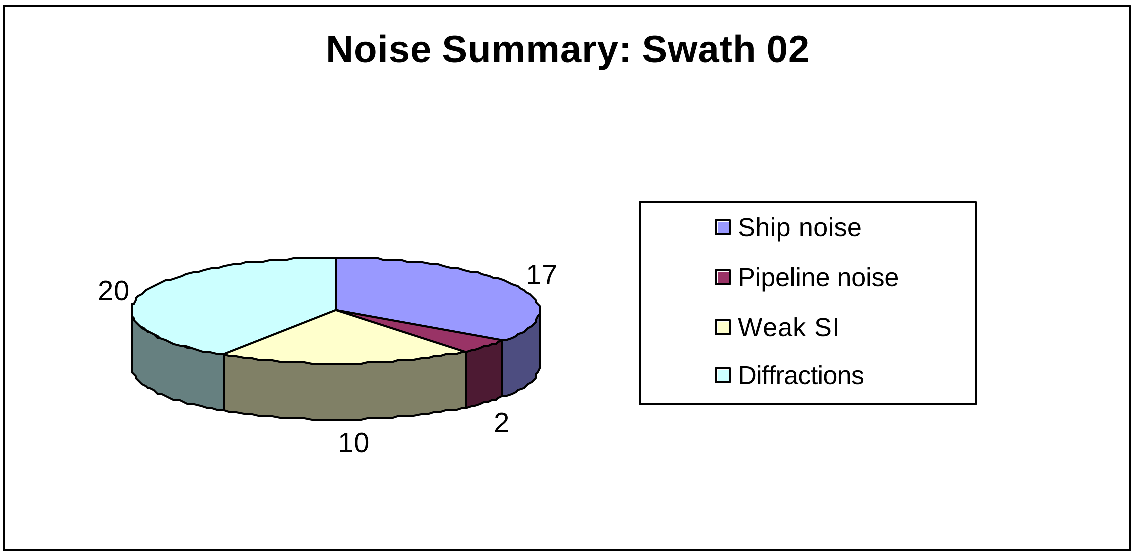


Figure 4. Chart showing frequency of noise types for Swath 02.

- Ship noise

Ship noise was the main source of noise this swath (Figures 5, 6 and 7) with sequences 108, 111, 119, 120, 121 and 129 being scratched due to the high levels of noise. The supply boat was usually in the vicinity of the rig, abeam of us, and the tankers passing to the south, so that the P and Y components were most affected by the noise. The noise on Seq 119-121 was caused by three tugs bring an accommodation block to the rig.

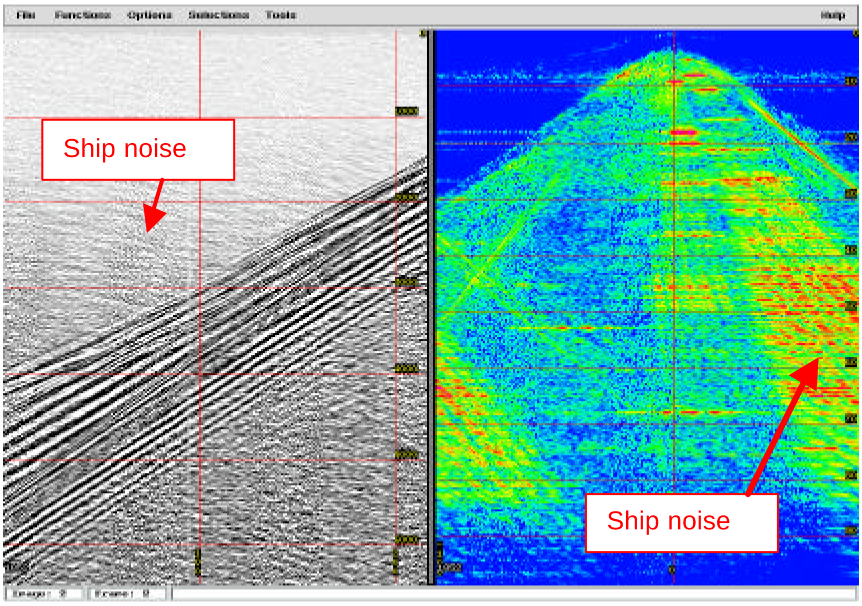


Figure 5. Shot and FK plot showing ship noise (Seq 129).

Second tanker

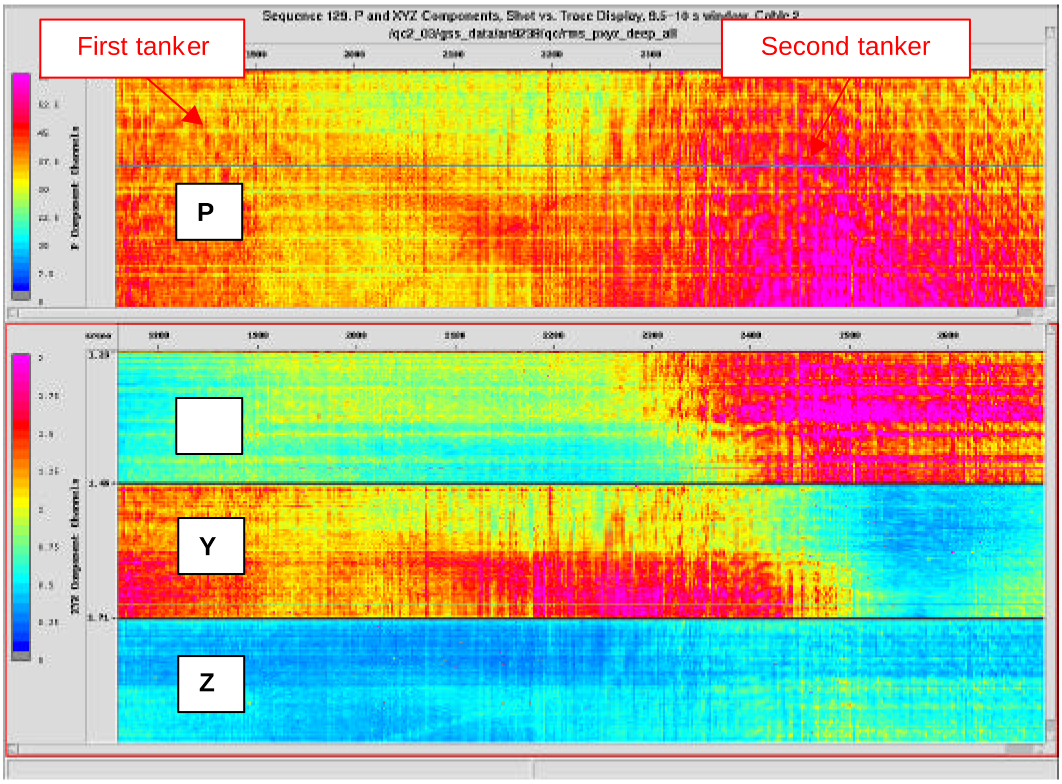


Figure 6. RMS_SVT plot showing shop noise (Seq 129).

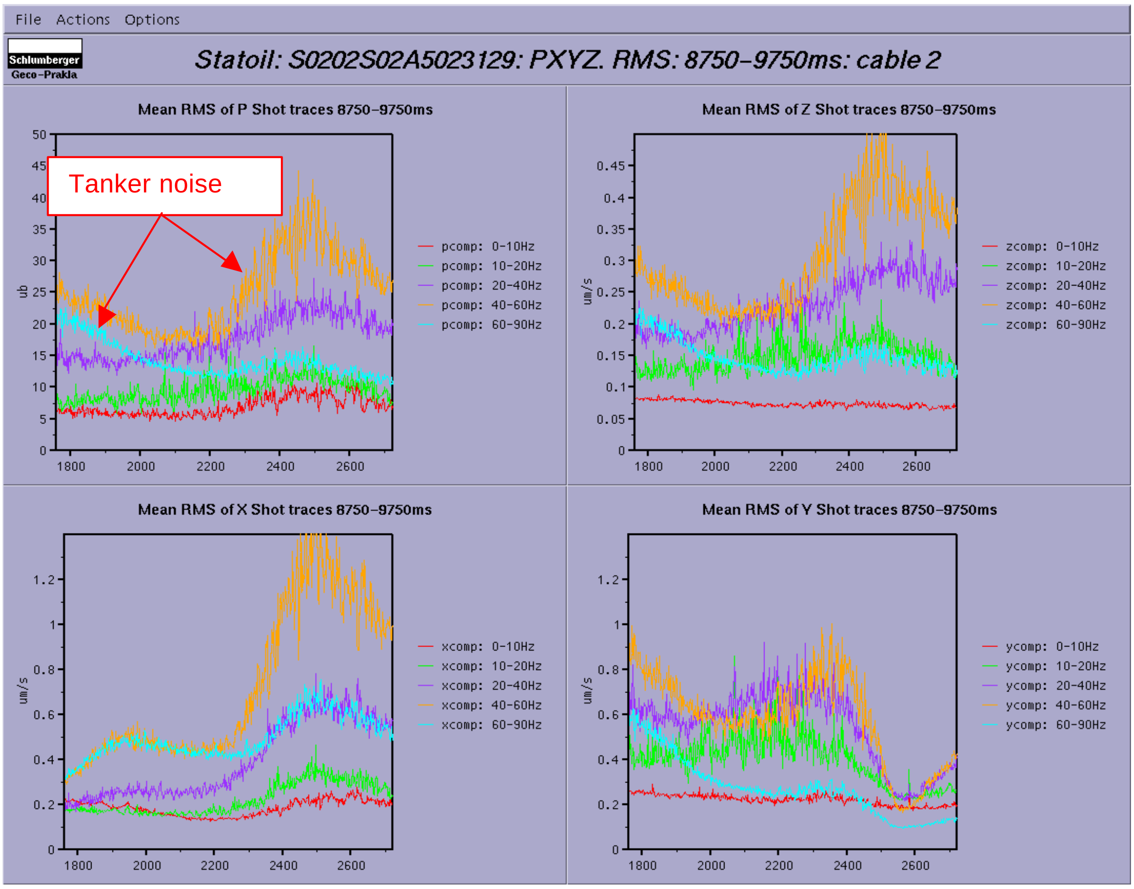


Figure 7. RMS_freq plot showing the frequencies affected by ship noise (Seq. 129).

- Seismic interference

Weak seismic interference (not from the Veritas Vantage) was seen on sequences 104, 107, 112, 113, 117, 122, 125-127 and 133. The origin of the seismic is to the NW.

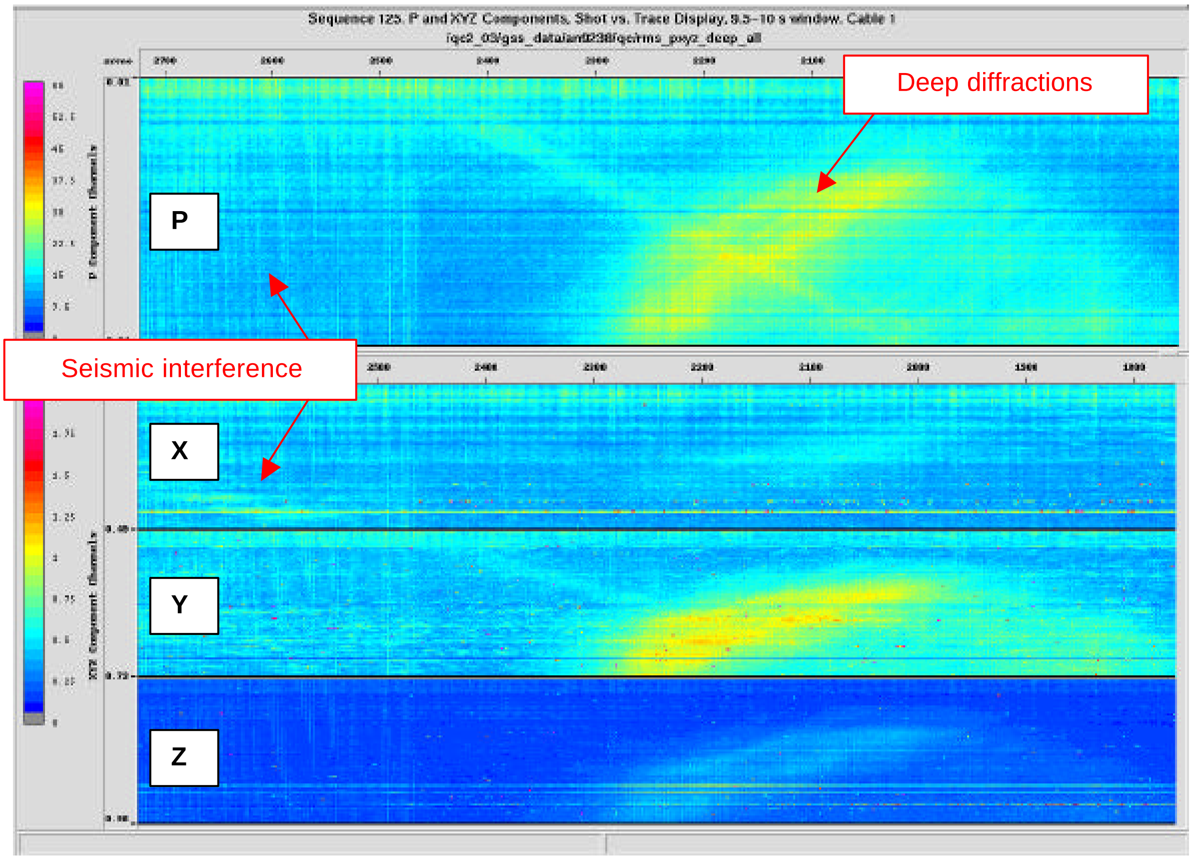


Figure 8. RMS_SVT plot showing seismic interference and diffractions (Seq 125).

- Spiking channels

The pipeline intersections are as follows:

Cable 1: 750m from the tail of the cable (approximately station number. 2061).
Channels affected:
X: 457, 458.
Y: 701, 702.
Z: 945, 946.

Cable 2: 670m from the tail of the cable (approximately station number 2055).
Channels affected:
X: 1436, 1437
Y: 1680, 1681
Z: 1924, 1925

This resulted in spiking channels that were noticeable on the RMS_SVT plot (Figure 9) and on the stack (Figure 10).

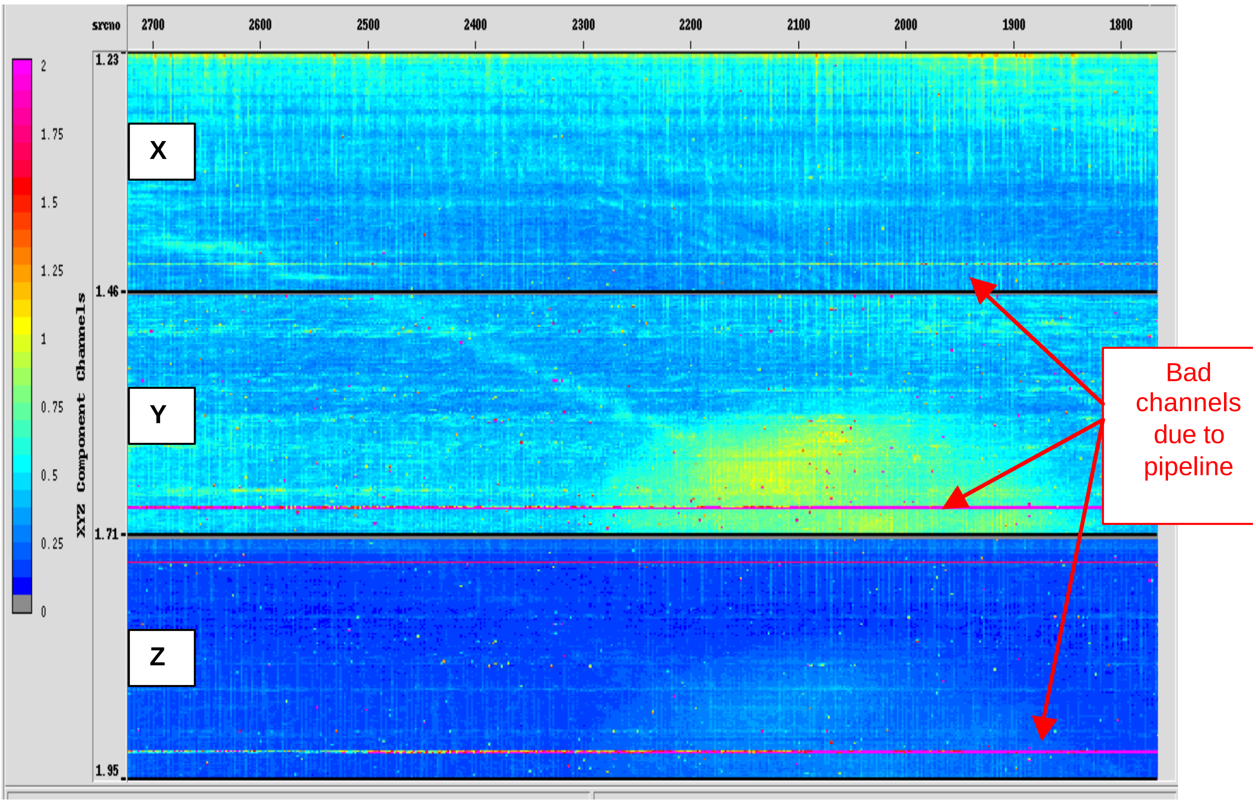


Figure 9. RMS_SVT plot showing noisy channels due to pipeline (Seq 104).

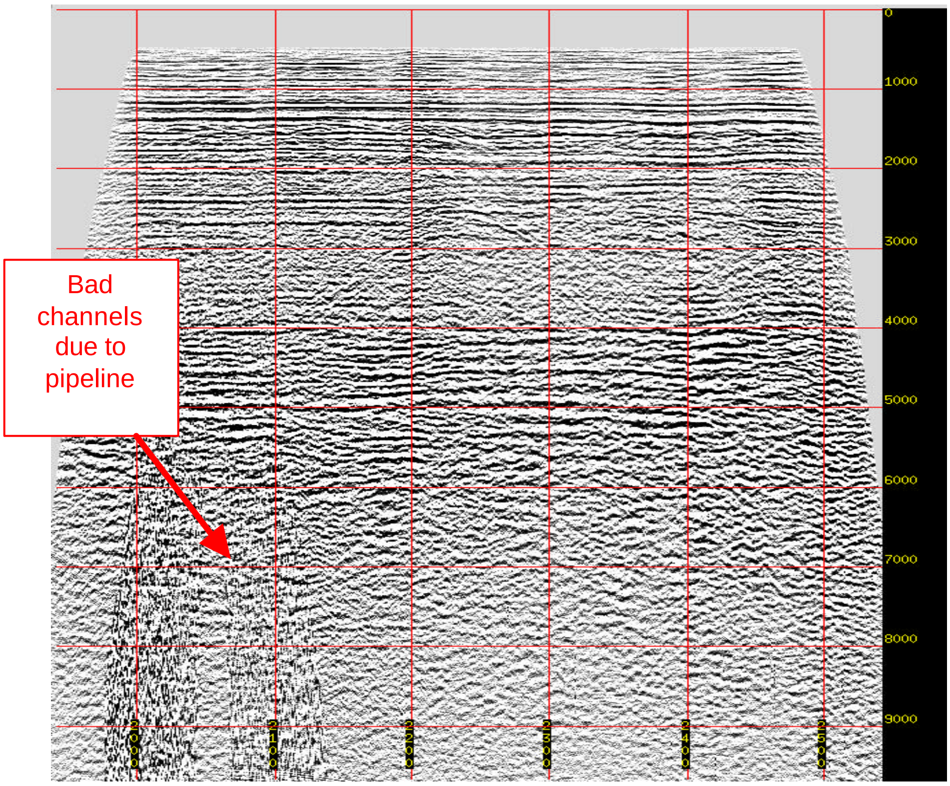


Figure 10: Channels with bad coupling visible on the Z component stack (Seq 104).

From Seq 105 onwards channels 702, 946, 1680, 1681, 1924 and 1925 were killed.

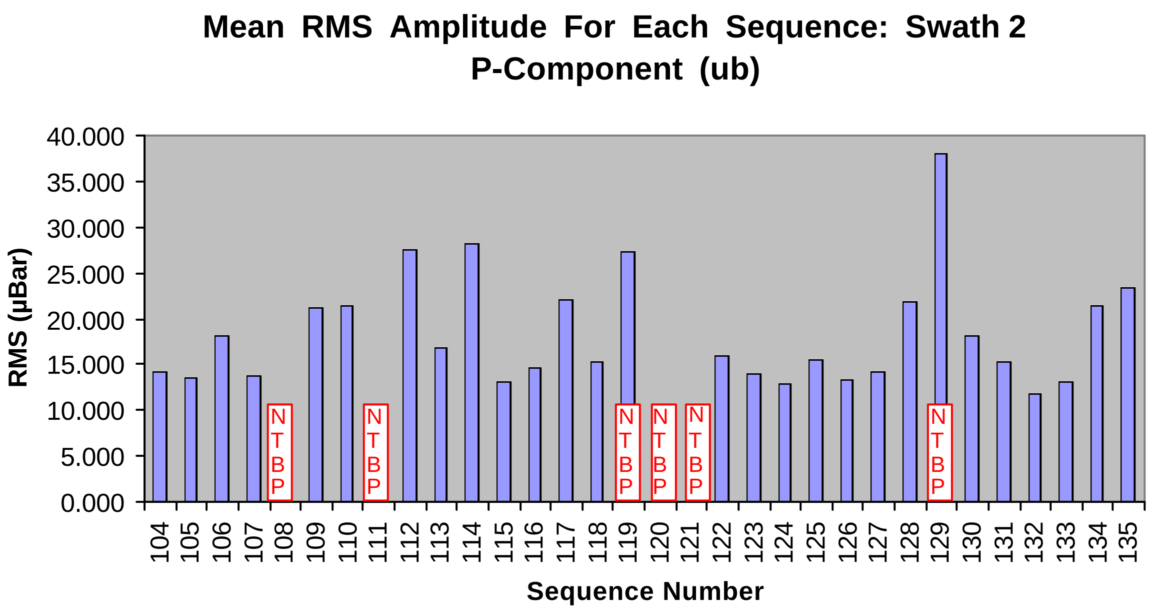
<u>Re-shoots</u>

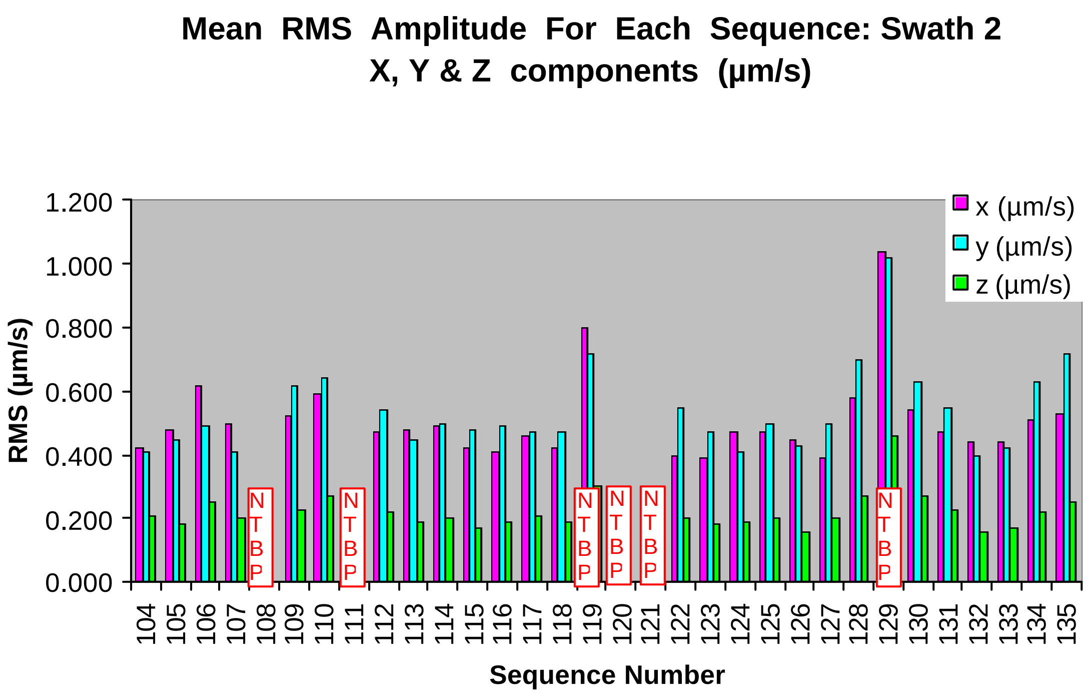
Seq	Reshoot	Reason for reshoot
108	109	Ship noise
111	115	Ship noise
Portion of 116	128	Nav
Portion of 118	131	Guns
119	129	Ship noise
120	121	Ship noise
121	122	Ship noise
129	130	Ship noise

Noise statistics

Average RMS noise levels for the whole swath were:

p **(mb)**	***x*** **(mm/s)**	***y*** **(mm/s)**	***z*** **(mm/s)**
15.90	0.43	0.45	0.19




Mean RMS Amplitude For Each Sequence: Swath 2
X, Y & Z components (µm/s)
RMS (µm/s)
1.200
1.000
0.800
0.600
0.400
0.200
0.000
x (µm/s)
y (µm/s)
z (µm/s)
NTBP
NTBP
NTBP
NTBP
NTBP
NTBP
104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135
Sequence Number

SWATH SUMMARY

Swath: 03 Sequences: 078 to 103

General location

Swath 3 was made of 24 shooting lines (5027 - 5119 incrementing by 4) and two receiver lines; cable 1: 5081, cable 2: 5065 (Figure 1).

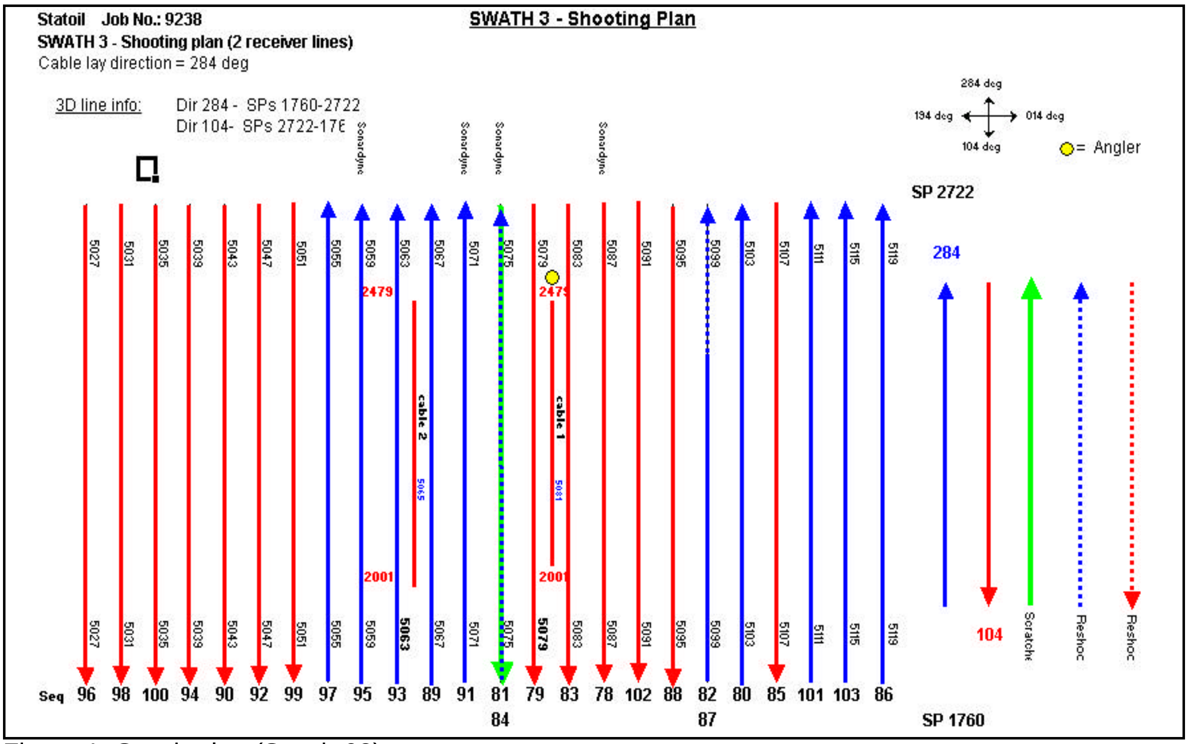


Figure 1: Swath plan (Swath 03).

A rig complex was situated on the south of the survey area (Figure 2).

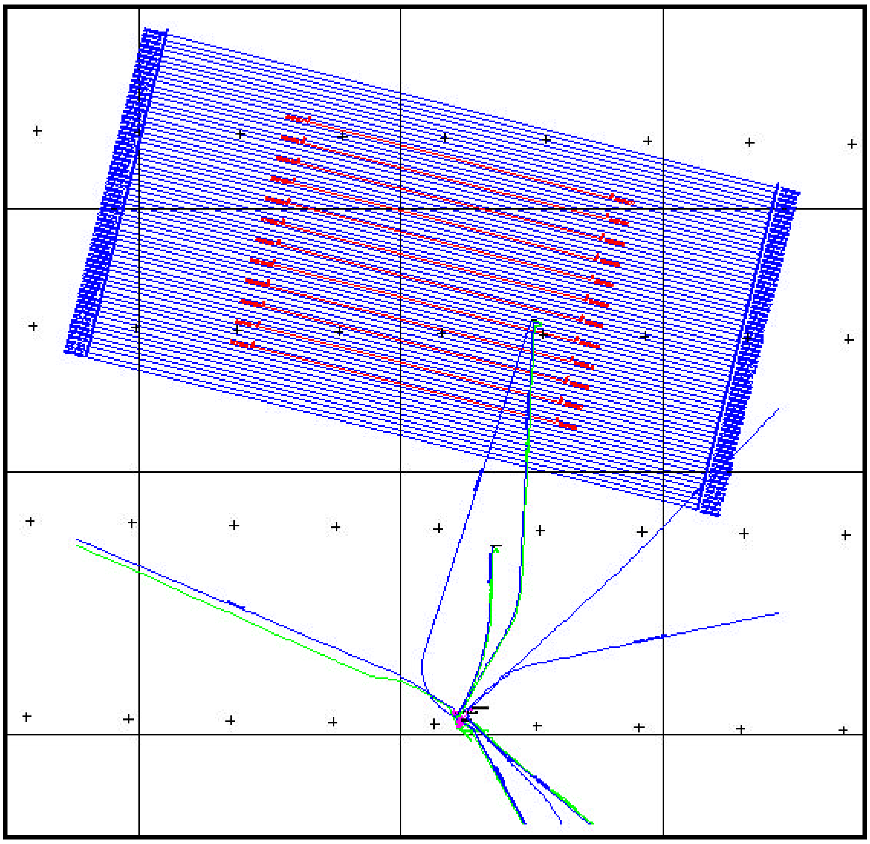


Figure 2: Rig complex location

During swath 03 we were time-sharing with the Veritas Vantage to the southwest in UK Sector Quad 15 (see Figure 3).

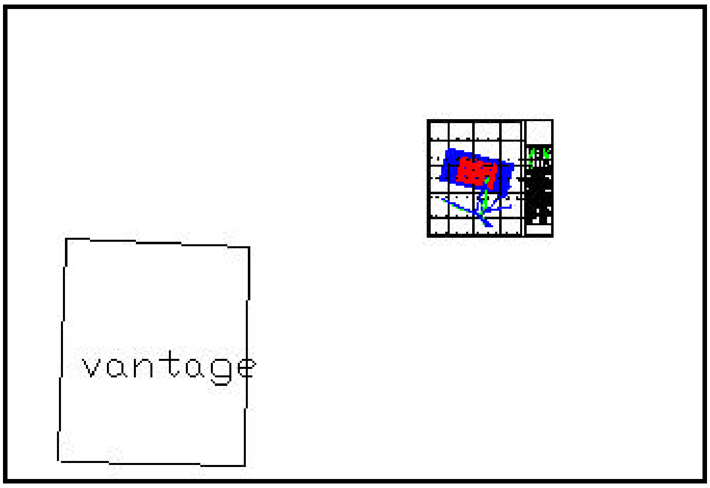


Figure 3: Seismic survey locations

Noise description

The most significant source of noise observed this swath was ship noise. Some weak seismic interference was also noted. Spiking geophone channels on cable two were seen for most sequences as the cable was laid over a pipeline. During the periods of bad weather, thruster noise from the Angler was detected at the head of both streamers, and the X component showed some spiking channels. Propeller noise from the Inlet was also seen during the periods of very bad weather.

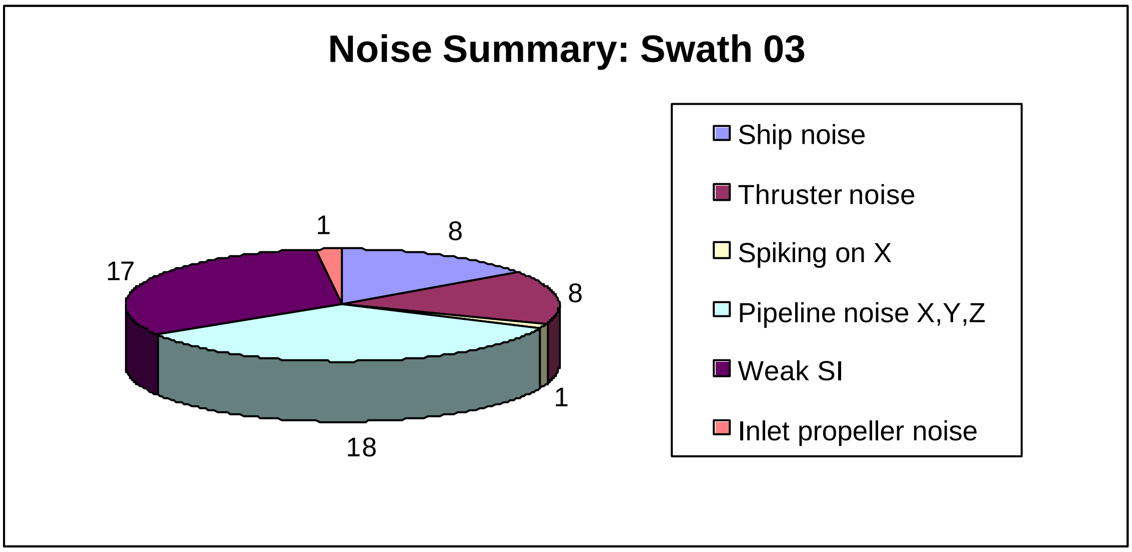


Figure 4. Chart showing frequency of noise types for Swath 03.

- Ship noise

Supply boats were the main source of ship noise this swath, Sequences 096, 097 and 098 being the worst. The supply boats were in the vicinity of the rig abeam of us, so that the P and Y components were most affected by the noise (See figures 5-7). The supply vessel noise is similar to swath 06 when the same supply boat was in the area.

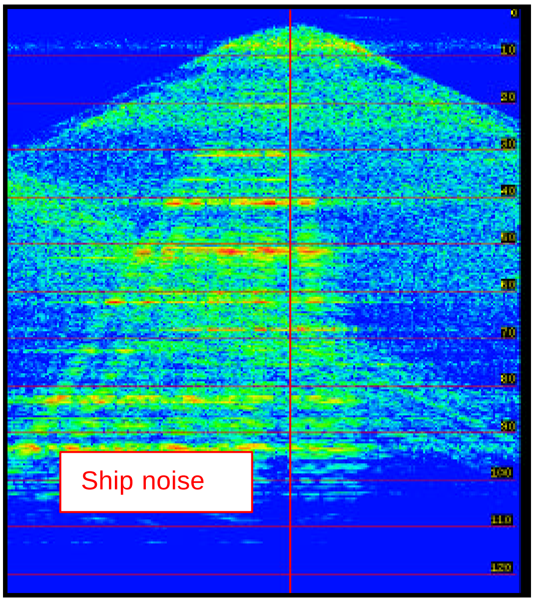


Figure 5. FK plot showing ship noise.

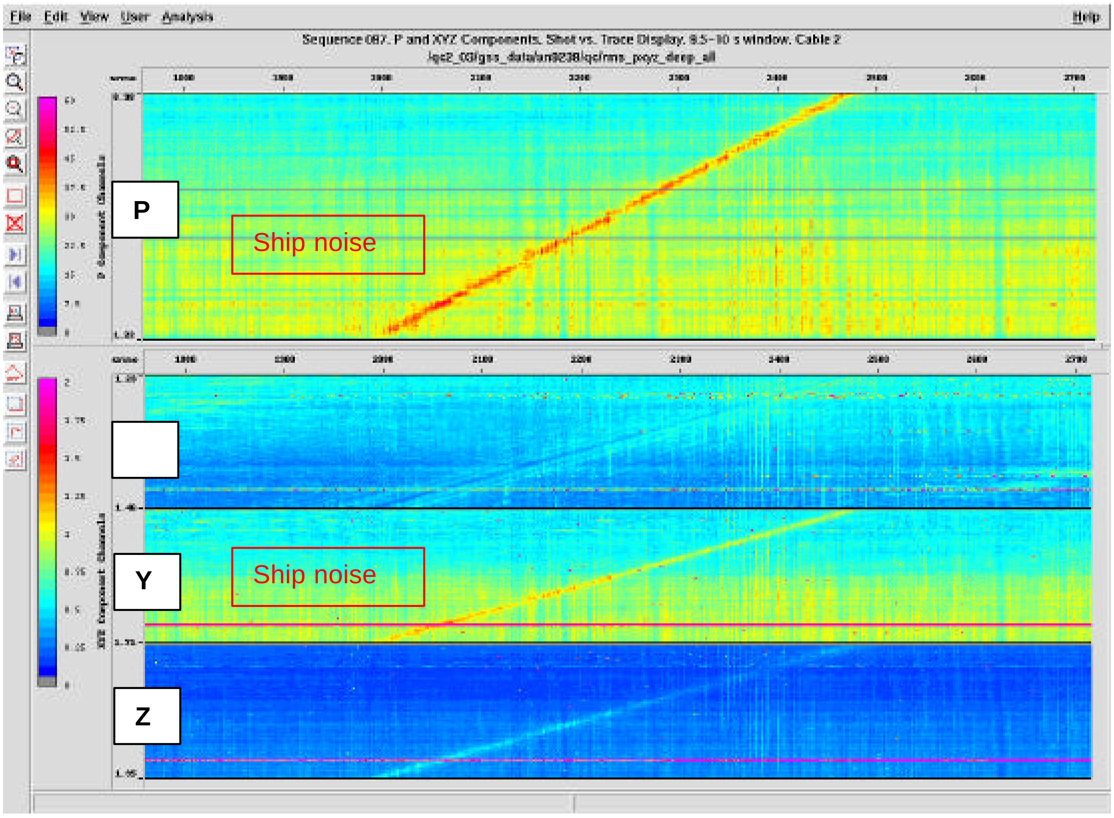


Figure 6. RMS_SVT plot showing shop noise on P and Y components (Seq 097).

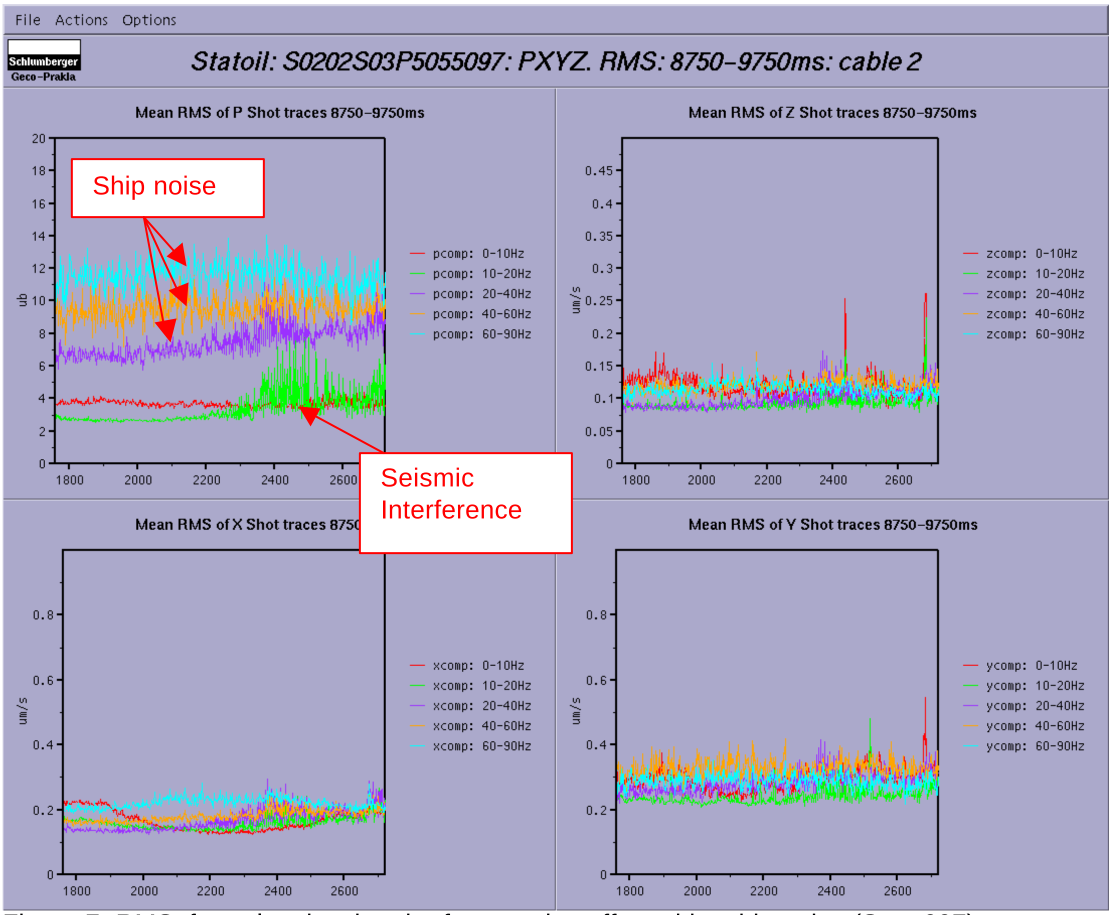


Figure 7. RMS_freq plot showing the frequencies affected by ship noise (Seq. 097).

- Seismic interference

Weak seismic interference (not from the Veritas Vantage) was seen on sequences 079-080, 082-088, 090, 092, 098, and 100-103. The origin of the seismic is to the NW.

- Thruster noise

When the sea conditions were bad or deteriorating (Seq. 079, 083 to 086, 090 to 092), some thruster noise from Geco-Angler was noticeable on the RMS plots as shown on figure 8.

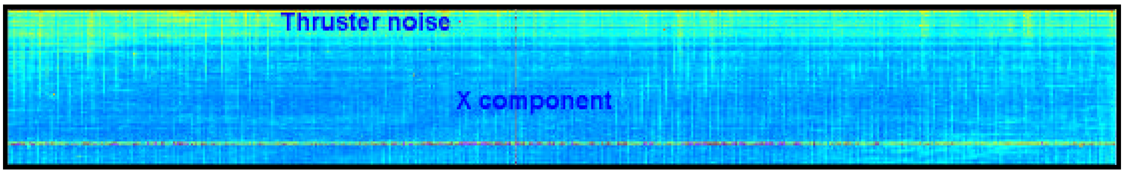


Figure 8. Thruster noise as seen on the RMS_SVT plot

This kind of noise is strongest on the X component and is only noticeable on the first quarter of the cable length.

- Propeller noise

Sequence 079 showed some low level noise bursts from the propellers on the Inlet during bad weather. This was most noticeable on the shots, and can occasionally be seen on the RMS_SVT plots.

- Spiking channels

One sequence showed spiking on the X component due to poor coupling of the cable on the seafloor during bad weather (Seq. 091).

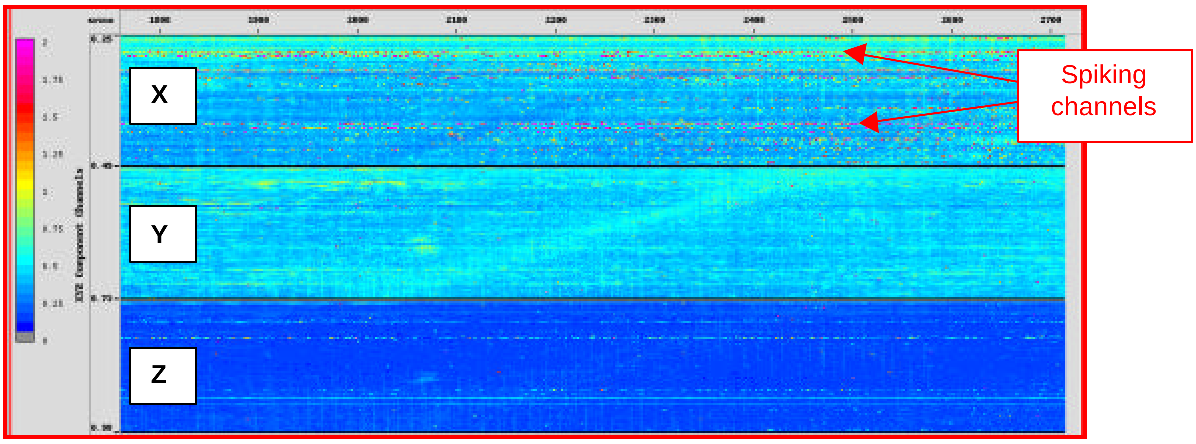


Figure 9. RMS_SVT plot showing spiking channels in the X component.

Cable 2 was lying over a pipeline resulting in bad coupling, causing 3 channels of each X, Y and Z components to be spiky or noisy on 17 lines (Seq. 078-086, 090-096, 098 and 099). See Figure 10 and 11.

Channels affected:

X component: 1430-1432
Y component: 1674-1976
Z component: 1918-1920

This resulted in spiking channels that were noticeable in the stack.

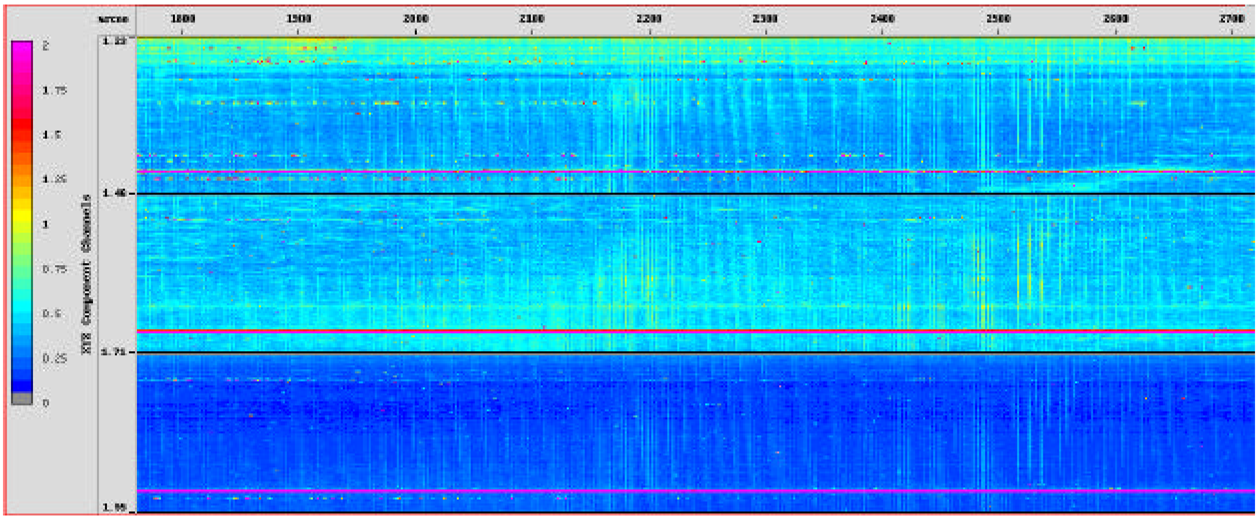


Figure 10: Channels with bad coupling on X, Y and Z components (pink stripes) on the RMS_SVT plot (deep window).

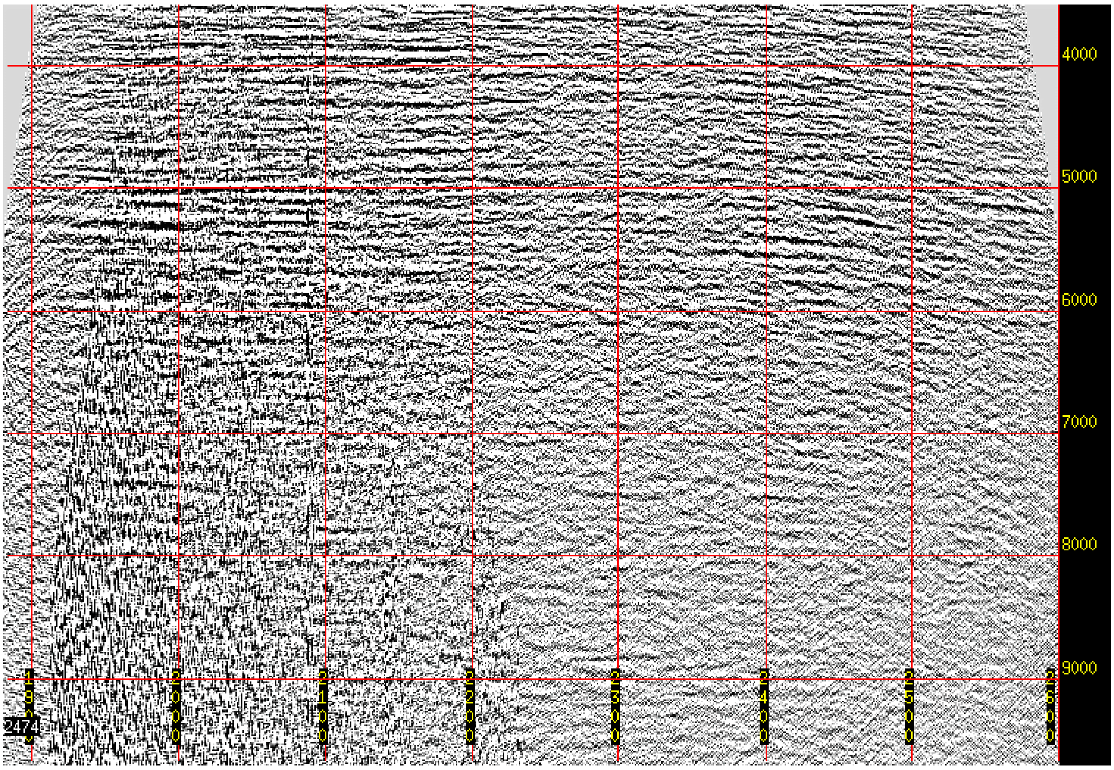


Figure 11 : Channels with bad coupling visible on the Z component stack.

Re-shoots

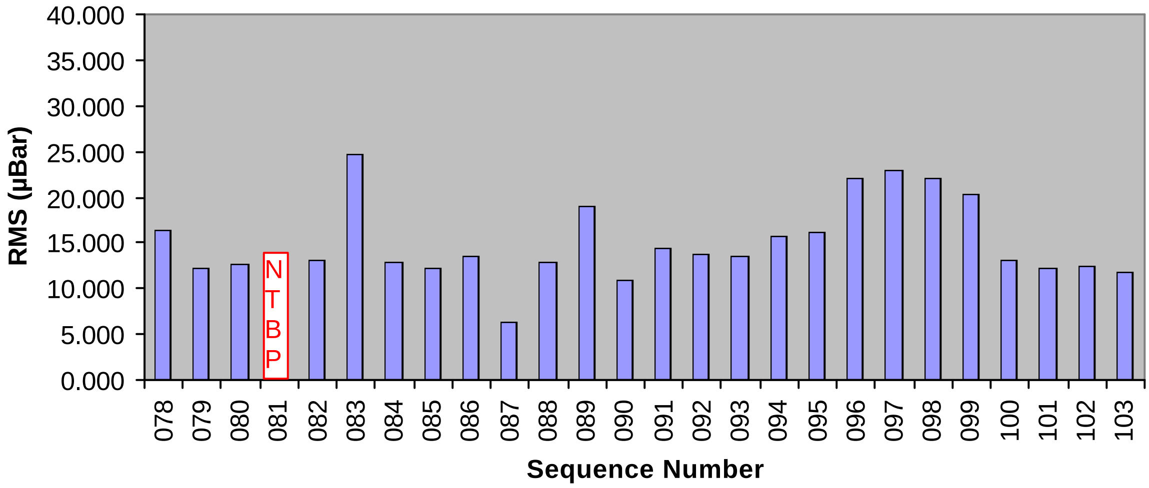
Sequence 081 was re-shot after being aborted due to gun problems.

Noise statistics

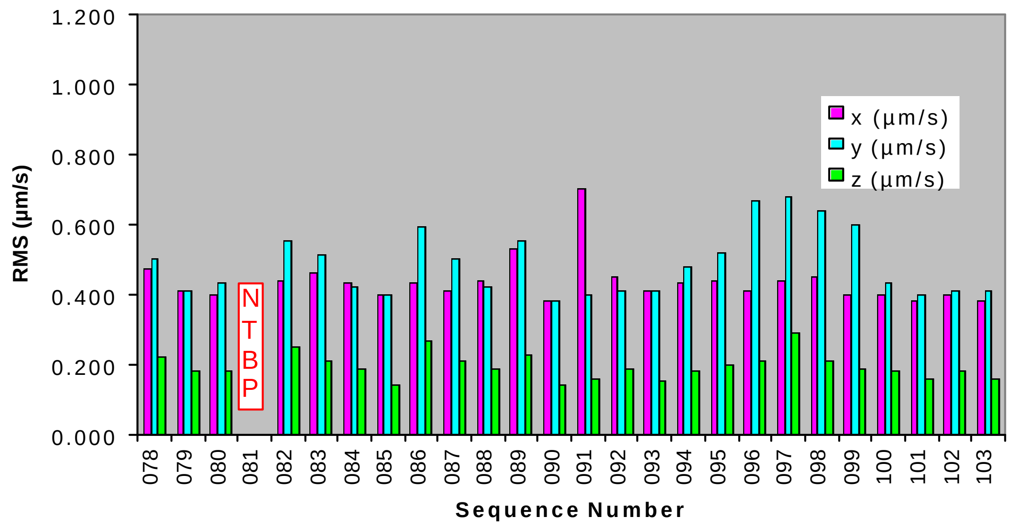
Average RMS noise levels for the whole swath were:

***p* (mb)**	***x* (mm/s)**	***y* (mm/s)**	***z* (mm/s)**
14.53	0.42	0.47	0.19

Mean RMS Amplitude For Each Sequence: Swath 3
P-Component (ub)



Mean RMS Amplitude For Each Sequence: Swath 3
X, Y & Z components (µm/s)



SWATH SUMMARY

Swath: 04 — Sequences: 026 to 051

General location

Swath 4 was made of 24 shooting lines (5059- 5151 incrementing by 4) and 2 receiver lines; cable 1: 5113, cable 2: 5097 (Figure 1).

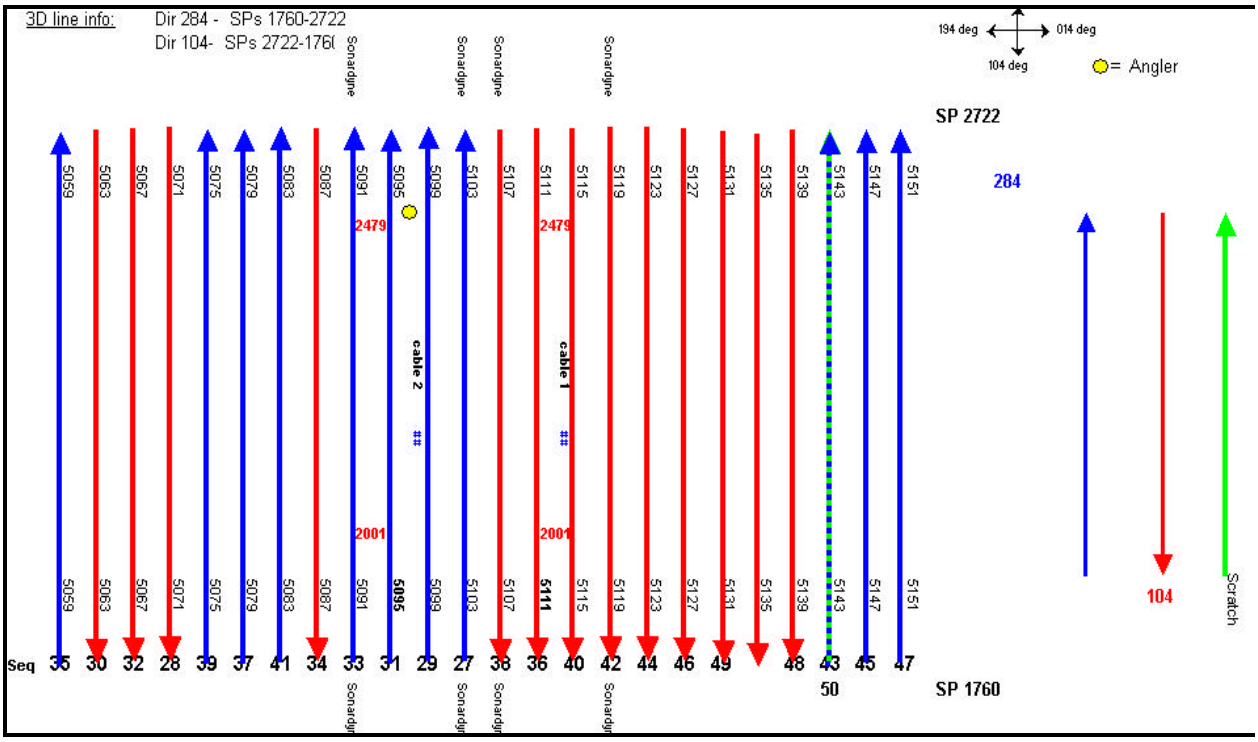


Figure 1: Swath plan (Swath 04).

A rig complex was situated on the south of the survey area (Figure 2).

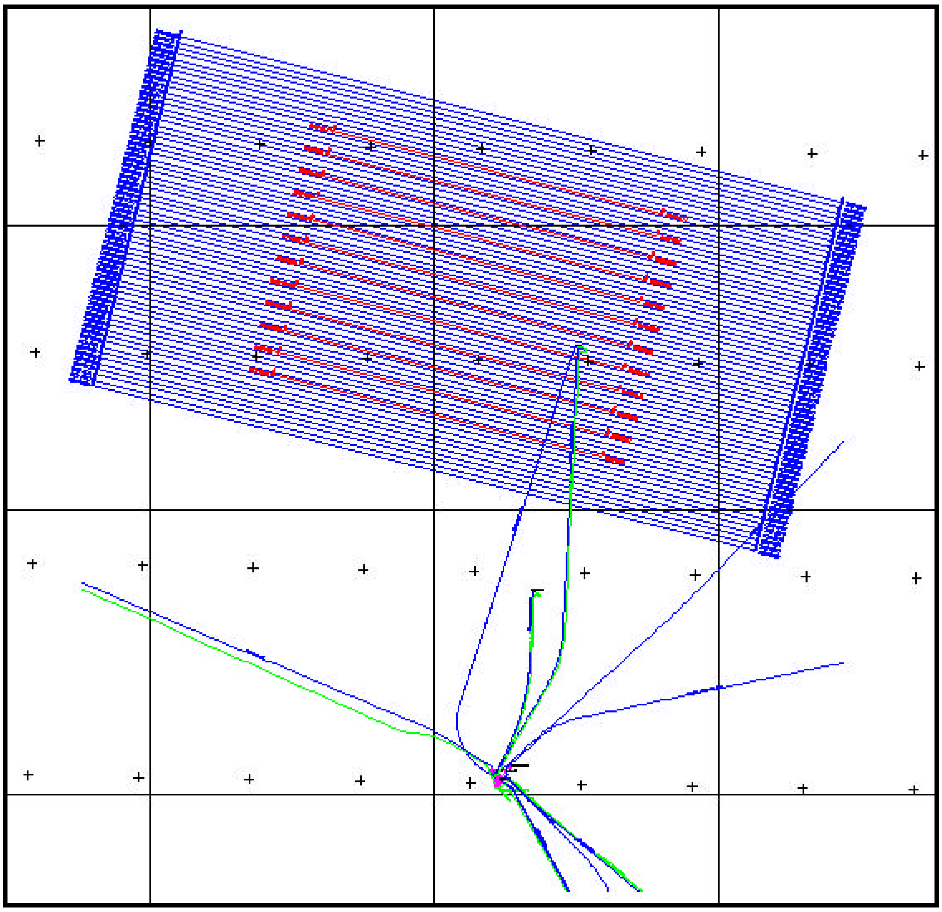


Figure 2: Rig complex location

During swath 04 we were time-sharing with the Veritas Vantage to the southwest in UK Sector Quad 15 (see Figure 3).

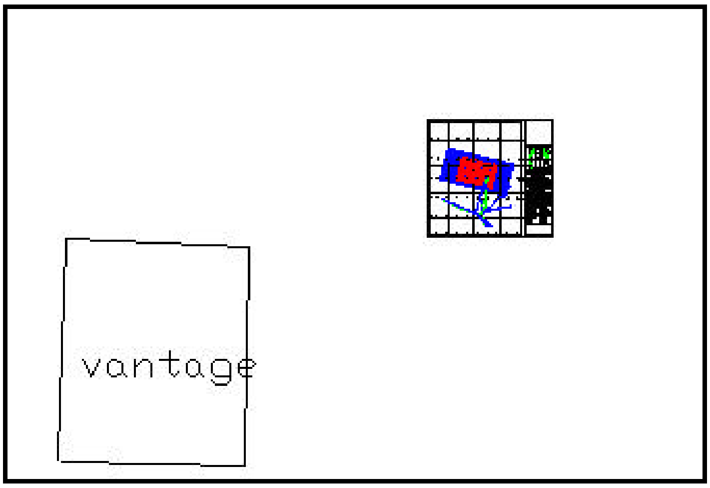


Figure 3: Seismic survey locations

Noise description

The main source of noise observed this swath was ship noise. Some weak seismic interference was also noted. During the periods of bad weather, thruster noise from the Angler was detected in the head of both streamers, and the X component showed some spiking channels. Propeller noise from the Inlet was also seen during the periods of very bad weather.

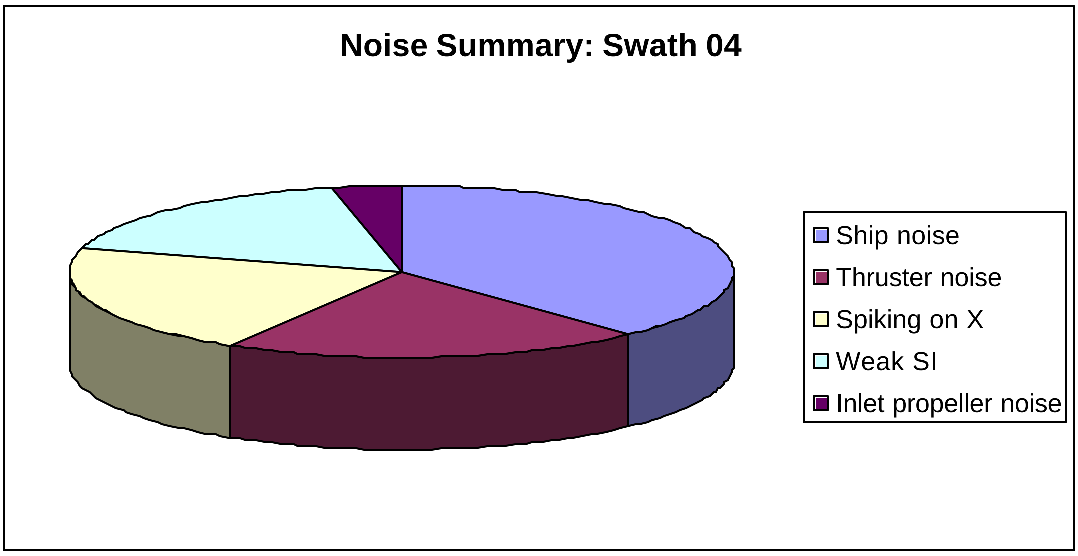


Figure 4. Chart showing frequency of noise types for Swath 04.

- Ship noise

Supply boats were the main source of ship noise this swath, Sequence 043 being the worst. The supply boats were generally in the vicinity of the rig, so that the P and Y components were most affected by the noise.

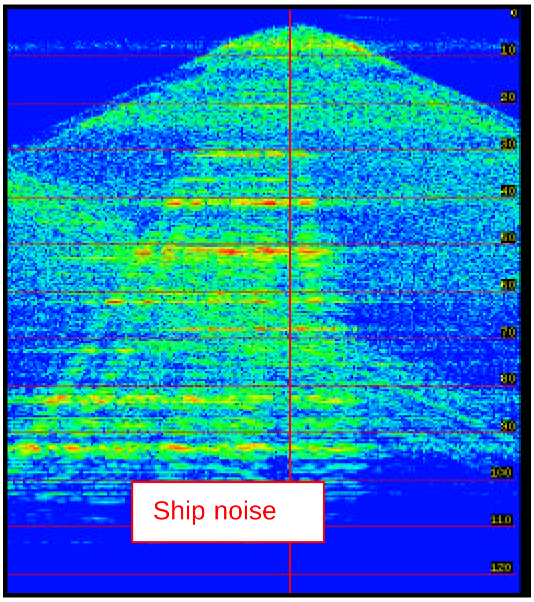


Figure 5. FK plot showing ship noise.

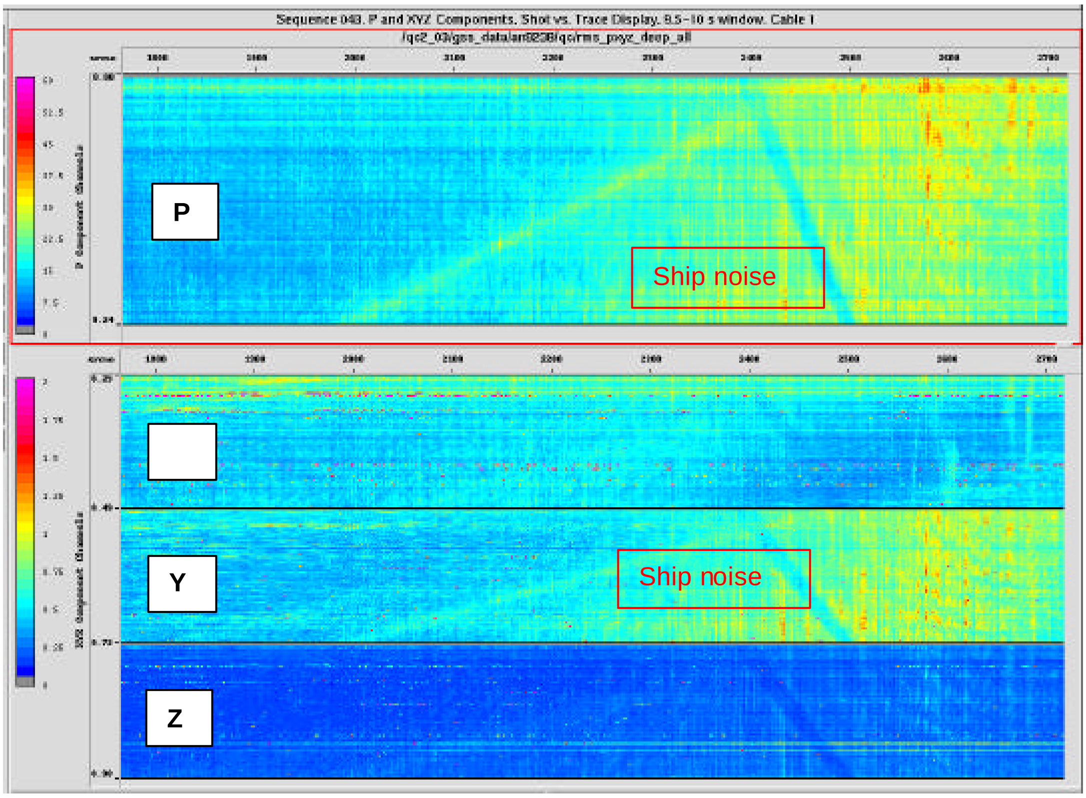


Figure 6. RMS_SVT plot showing shop noise on P and Y components (Seq 043).

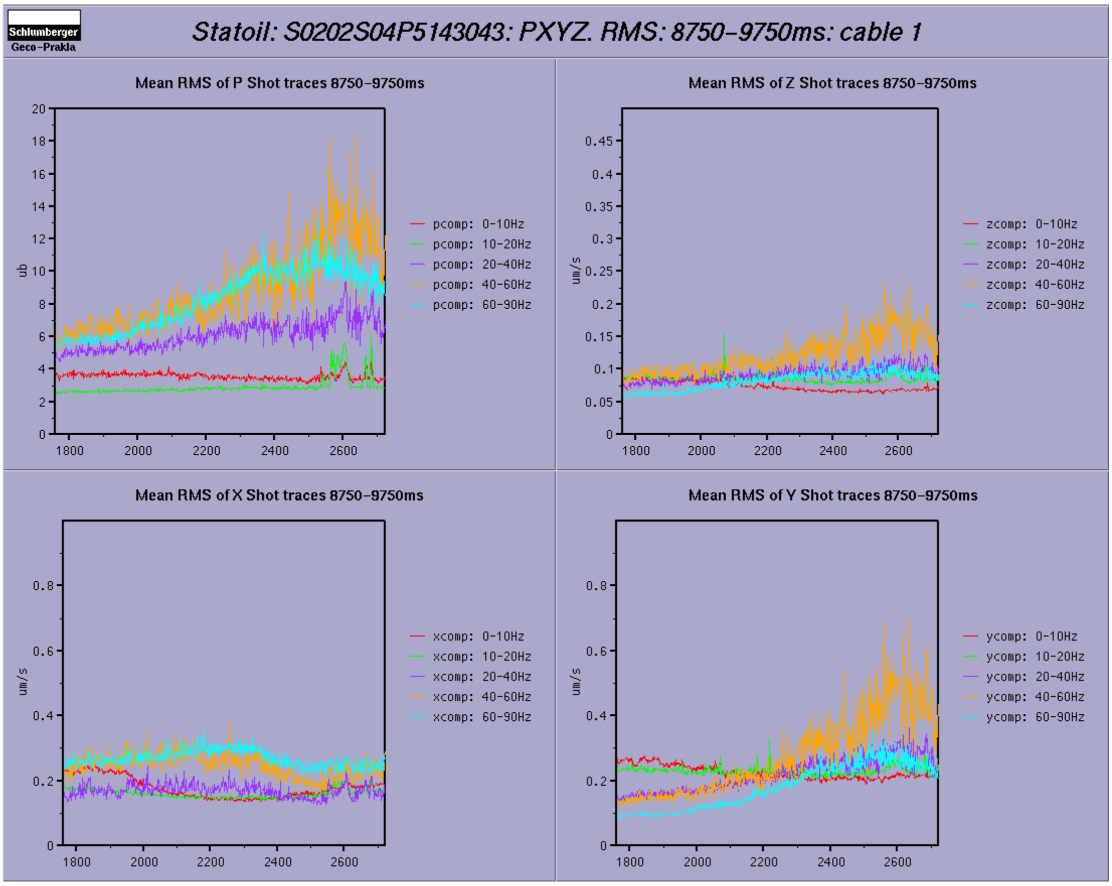


Figure 7. RMS_freq plot showing the frequencies affected by ship noise (Seq. 043).

- Seismic interference

Weak seismic interference (not from the Veritas Vantage) was seen on sequences 030, 031, 038, 039 and 044.

- Thruster noise

When the sea conditions were deteriorating (Seq.029, 030, 032, 033, 035, 036), some thruster noise from Geco-Angler was noticeable on the RMS plots as shown on figure 4.

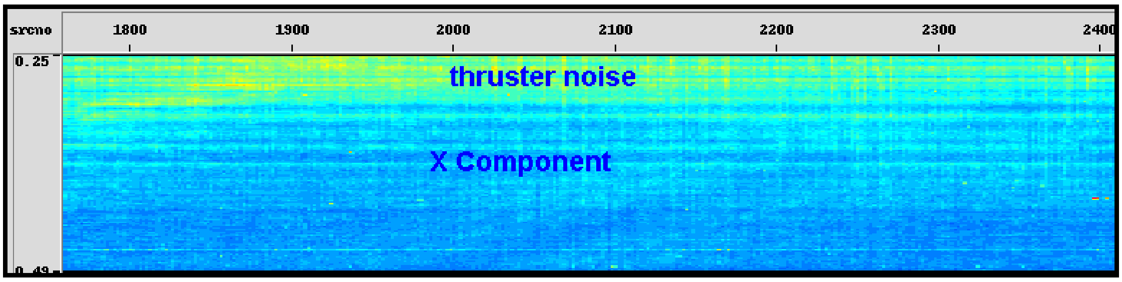


Figure 8. Thruster noise as seen on the RMS_SVT plot

This kind of noise is strongest on the X component and is only noticeable on the first quarter of the cable length.

- Propeller noise

Sequence 038 showed some low level noise bursts from the propellers on the Inlet. This was most noticeable on the shots, and can be seen on the RMS_SVT plots.

- Spiking channels

Six sequences showed spiking on the X component due to poor coupling of the cable on the seafloor during periods of bad weather (Seq 031, 032, 035, 036, 040, 042).

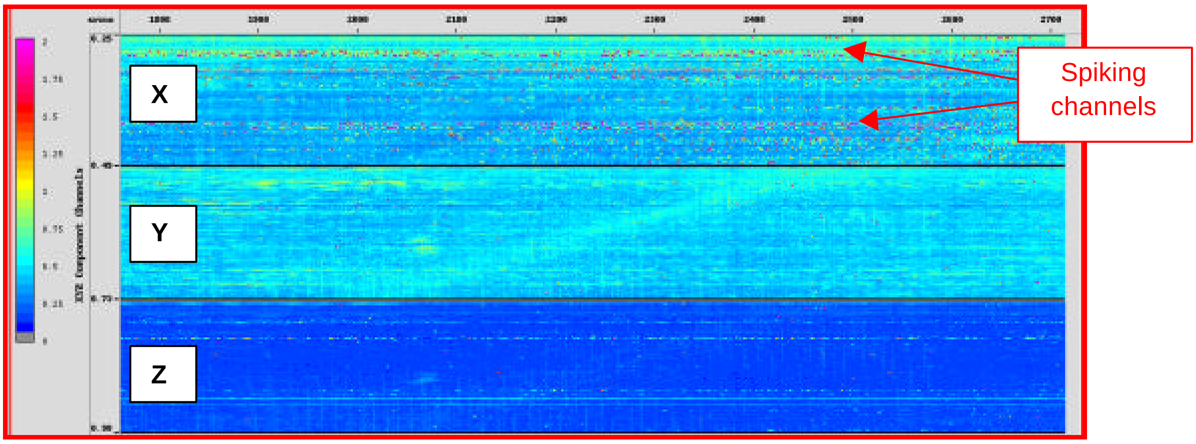


Figure 9. RMS_SVT plot showing spiking channels in the X component.

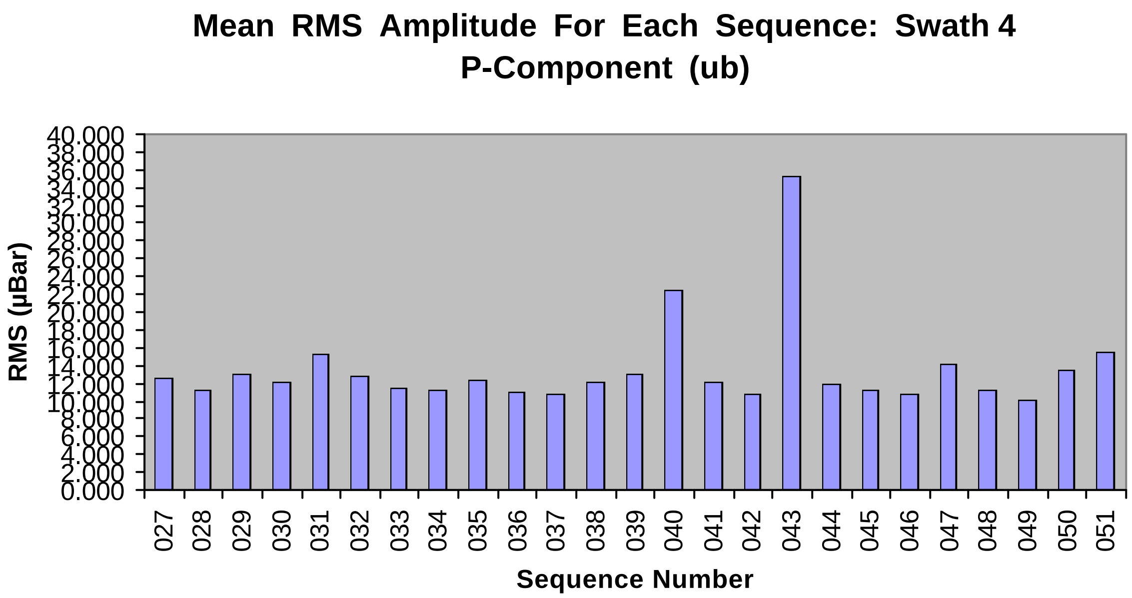
Re-shoots

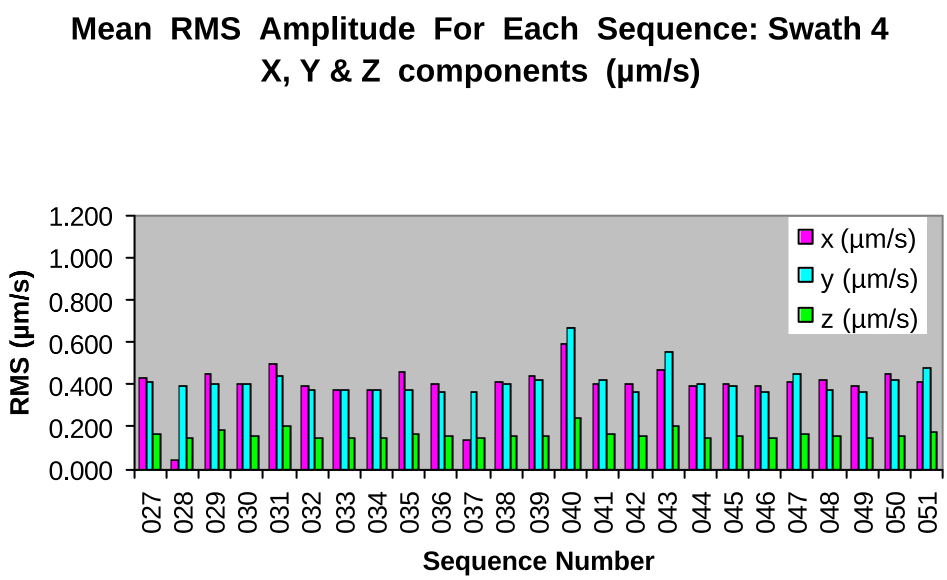
Sequence 043 was re-shot due to ship noise from a supply vessel coming along side one of the rigs.

Noise statistics

Average RMS noise levels for the whole swath were:

p **(μb)**	***x*** **(μm/s)**	***y*** **(μm/s)**	***z*** **(μm/s)**
13.52	0.40	0.42	0.17


Mean RMS Amplitude For Each Sequence: Swath 4
P-Component (ub)
RMS (µBar)
40.000
38.000
36.000
34.000
32.000
30.000
28.000
26.000
24.000
22.000
20.000
18.000
16.000
14.000
12.000
10.000
8.000
6.000
4.000
2.000
0.000
027
028
029
030
031
032
033
034
035
036
037
038
039
040
041
042
043
044
045
046
047
048
049
050
051
Sequence Number


Mean RMS Amplitude For Each Sequence: Swath 4
X, Y & Z components (µm/s)
RMS (µm/s)
1.200
1.000
0.800
0.600
0.400
0.200
0.000
x (µm/s)
y (µm/s)
z (µm/s)
027
028
029
030
031
032
033
034
035
036
037
038
039
040
041
042
043
044
045
046
047
048
049
050
051
Sequence Number

SWATH SUMMARY

Swath: 06 Sequences: 052 to 077

General location

Swath 6 was made of 24 shooting lines (5123 - 5215 incrementing by 4) and two receiver lines; cable 1: 5177, cable 2: 5161 (Figure 1).

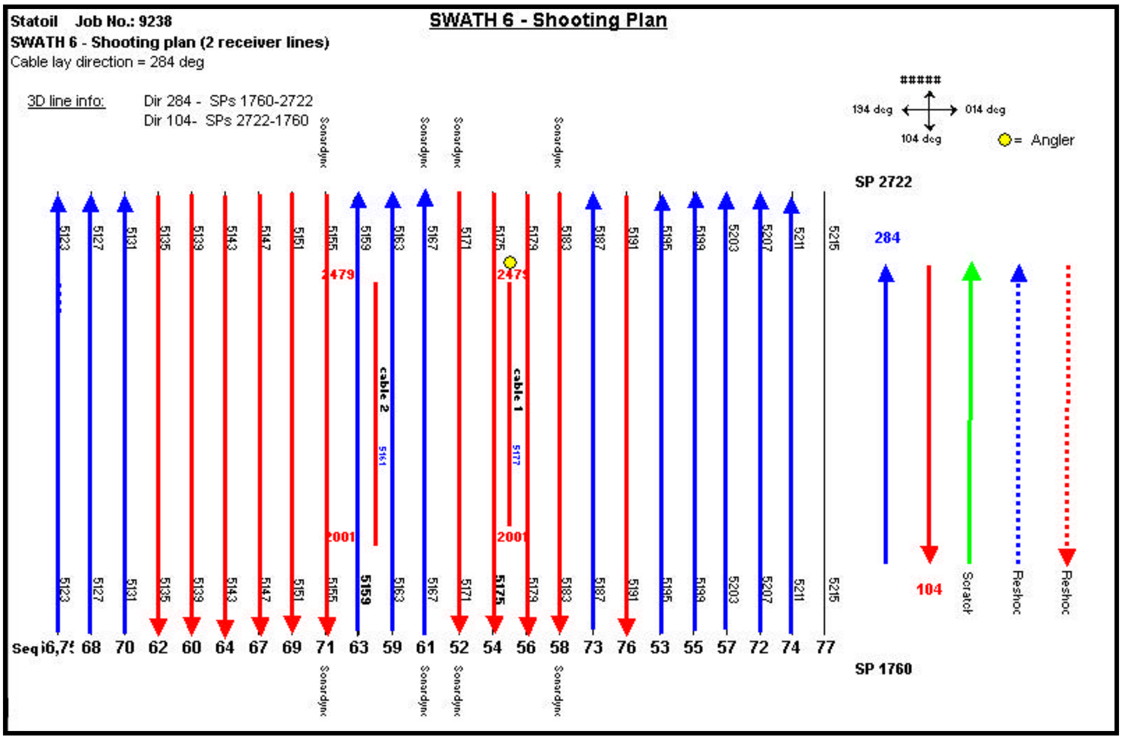


Figure 1: Swath plan (Swath 06).

A rig complex was situated on the south of the survey area (Figure 2).

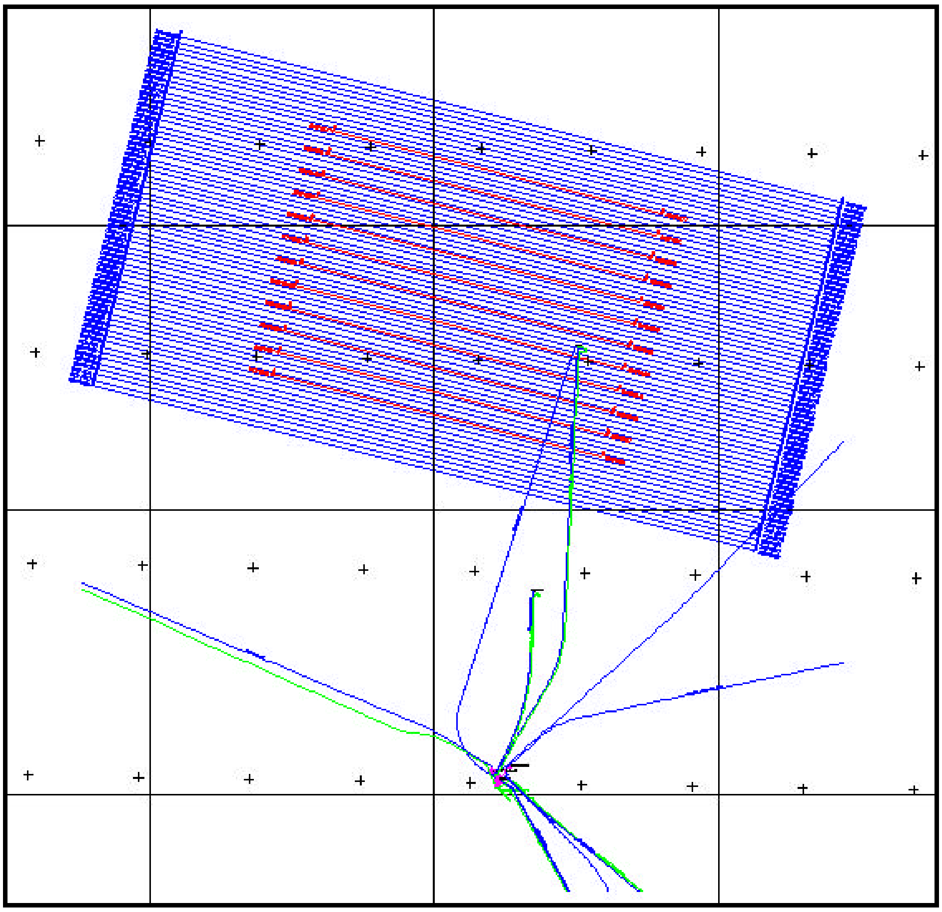


Figure 2: Rig complex location

During swath 06 we were time-sharing with the Veritas Vantage to the southwest in UK Sector Quad 15 (see Figure 3).

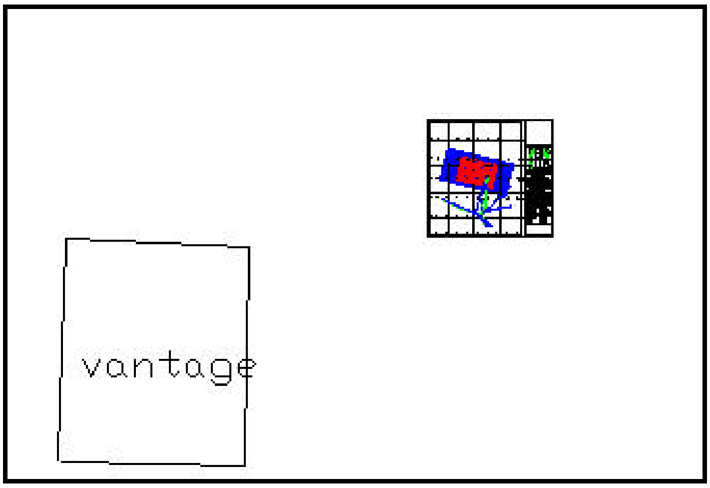


Figure 3: Seismic survey locations

<u>Noise description</u>

The main source of noise observed this swath was thruster noise from the Angler during times of bad weather. Propeller noise from the Inlet was also seen during the periods of very bad weather. Some weak seismic interference was also noted. The Y, Z and X component showed some spiking channels due to poor couple on a few sequences.

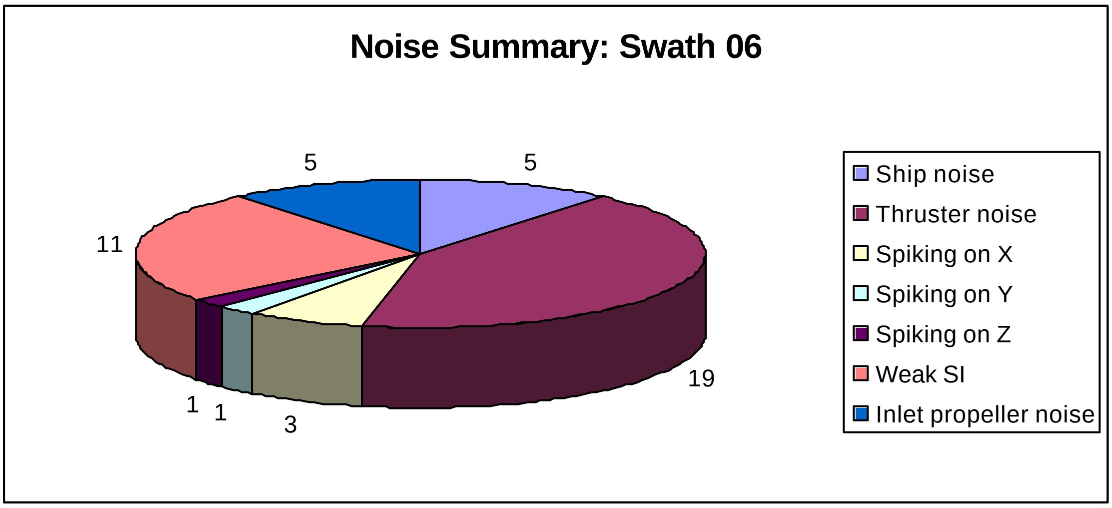


Figure 4. Chart showing frequency of noise types for Swath 06.

- Ship noise

Ship noise was not a significant source of noise this swath. Sequences 052, 053, 062, 063and 064 show ship noise.

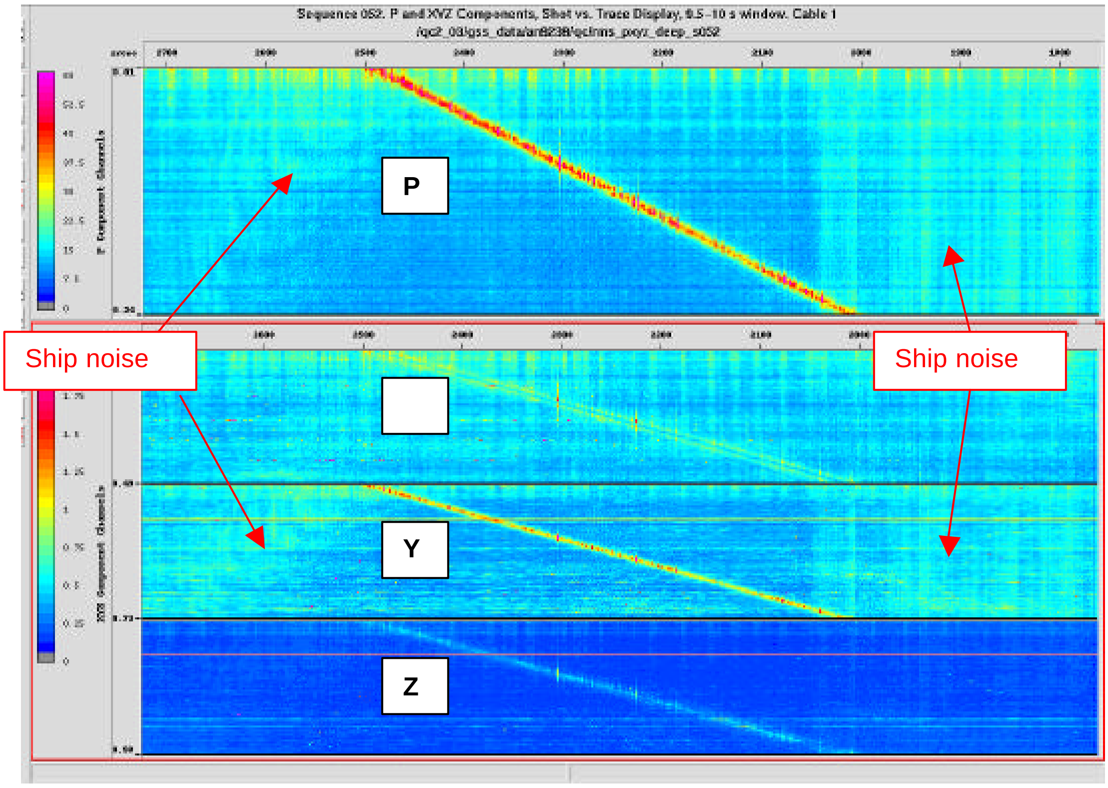


Figure 5. RMS_SVT plot showing ship noise (Seq 052).

- Seismic interference

Weak seismic interference (not from the Veritas Vantage) was seen on sequences 054-064.

- Thruster noise

When the sea conditions were deteriorating thruster noise from Geco-Angler was noticeable on the RMS plots as shown on figure 4.

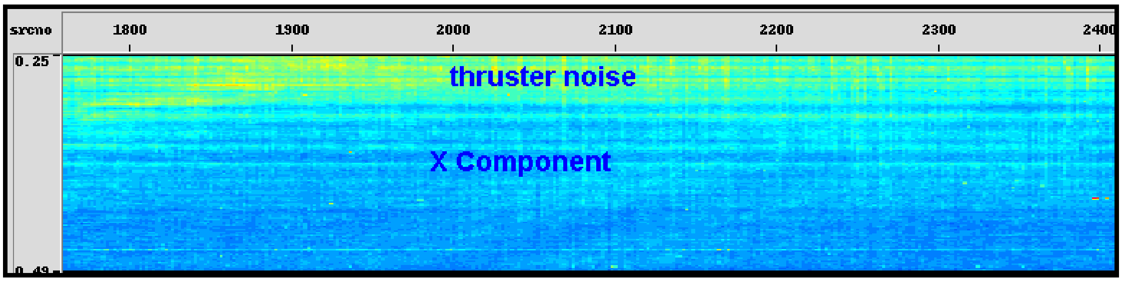


Figure 6. Thruster noise as seen on the RMS_SVT plot

This kind of noise is strongest on the X component and is only noticeable on the first quarter of the cable length. Sequences that showed thrusters noise this swath include Seq.053, 055, 056, 059, 061, 062, 063, 064, 066-070 and 072-077.

- Propeller noise

Sequence 056, 061, 066, 072 and 076 show some low level noise bursts from the propellers on the Inlet due to the bad weather conditions. This was most noticeable on the shots, and can be seen on the RMS_SVT plots.

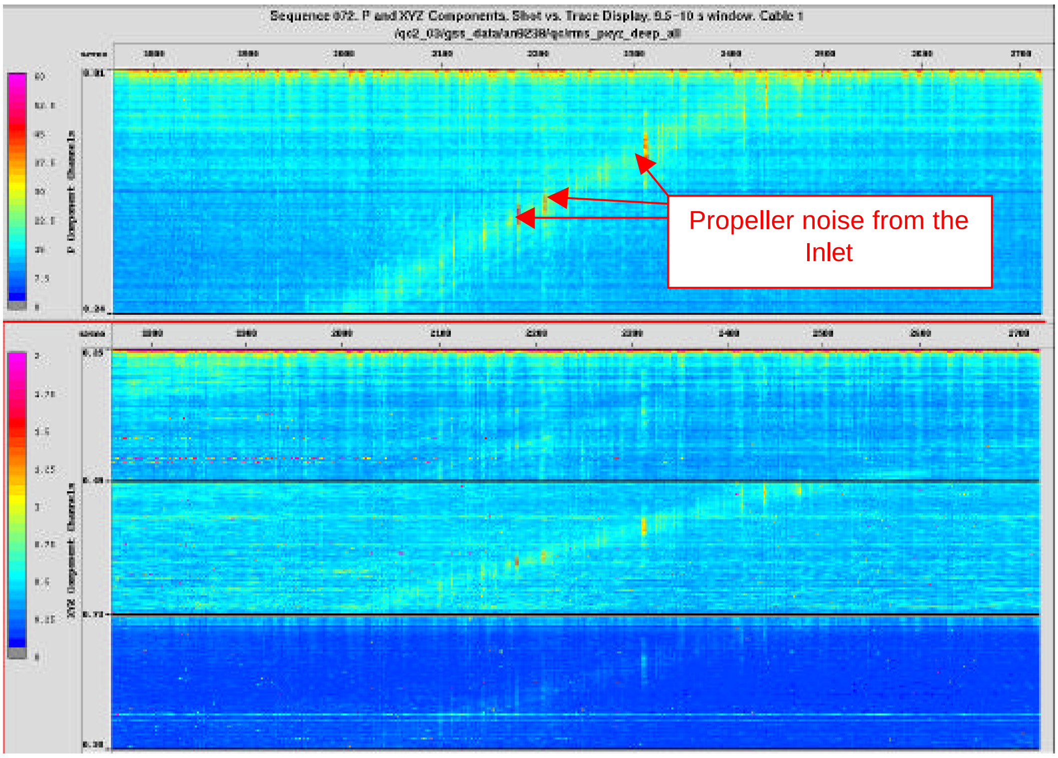


Figure 7: Propeller noise from the Inlet (Seq 072)

- Spiking channels

Three sequences showed spiking on the X component due to poor coupling of the cable on the seafloor during periods of bad weather (Seq 071, 072, 077). Spiking on the Y component was noted on Seq. 052, and on the Z component on Seq. 064.

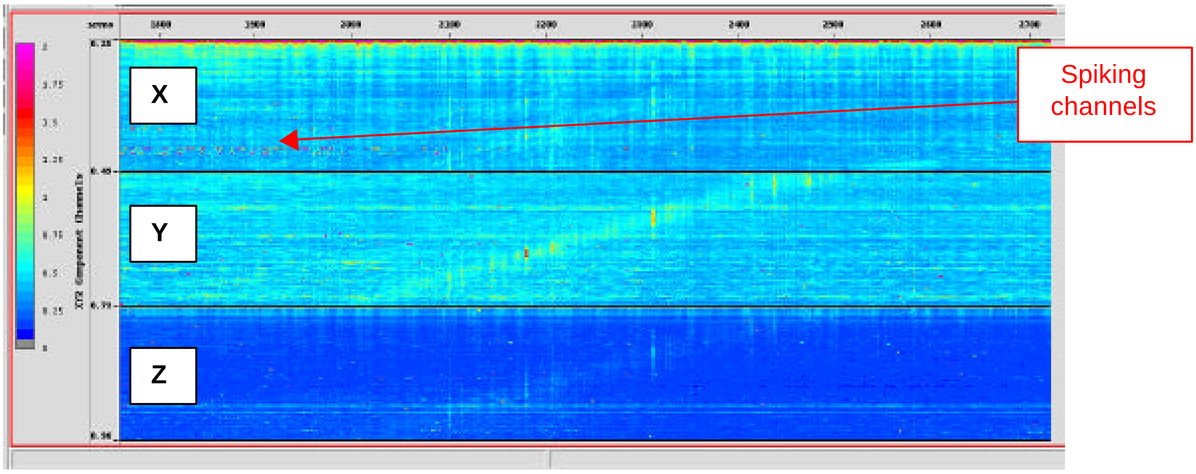


Figure 8. RMS_SVT plot showing spiking channels in the X component (Seq 072).

Re-shoots

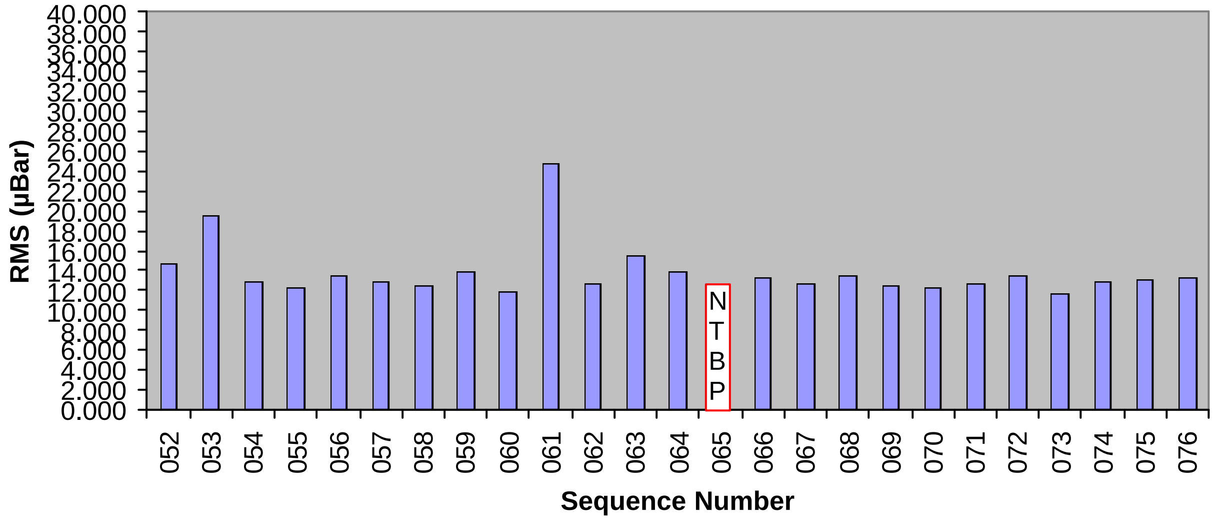
No reshoots were due to noise. Sequence 065 was re-shot due to the guns being out of spec on the Inlet .

Noise statistics

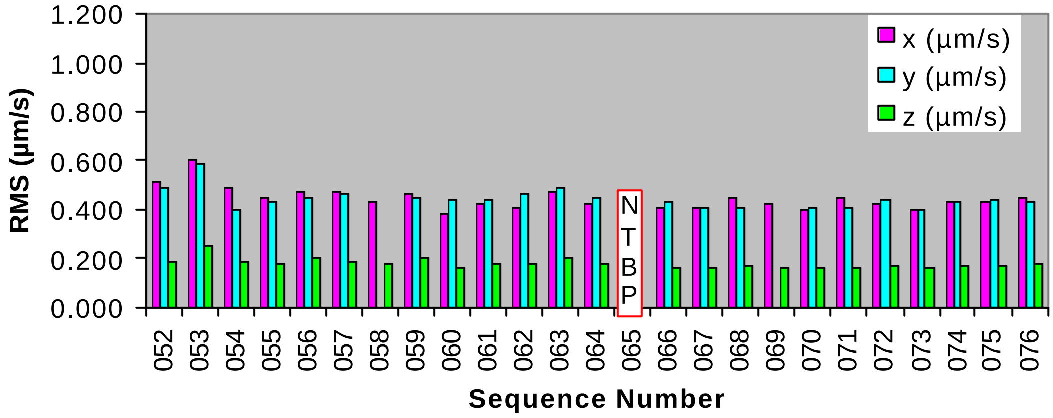
Average RMS noise levels for the whole swath were:

***p* (mb)**	***x* (mm/s)**	***y* (mm/s)**	***z* (mm/s)**
13.26	0.43	0.42	0.17

Mean RMS Amplitude For Each Sequence: Swath 6
P-Component (ub)



Mean RMS Amplitude For Each Sequence: Swath 6
X, Y & Z components (µm/s)



24.3 Polarity Test

A polarity test was performed at the start of the survey to test the polarity of the recorded data. The polarity of the response of each component, to a shot at known location, was tested for each cable (one cable (cable 1) test is shown below).

The test was performed by analysing the first breaks of the recorded signal from a shot/receiver combination giving a nominal cross-line offset and a nominal inline offset larger than zero.

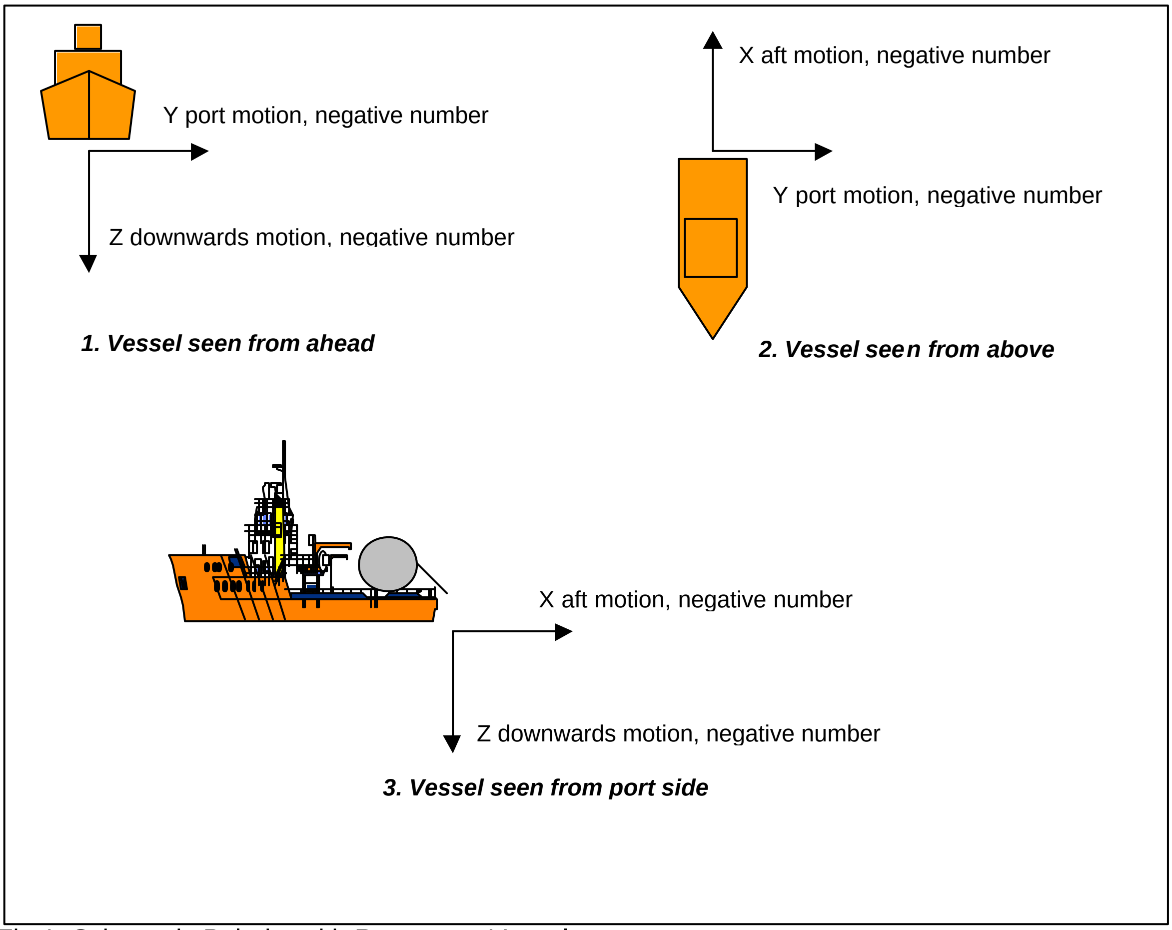


Fig 1. Schematic Polarity with Respect to Vessel

The test for polarity on cable 1 is shown below. The polarity of the other cable used was checked in the same manner.

Test Shot Parameters

Swath: 01
Sequence: 026
Cable: 1
Receiver Line: 5017
Source Line: 5019
Shot Point: 2242

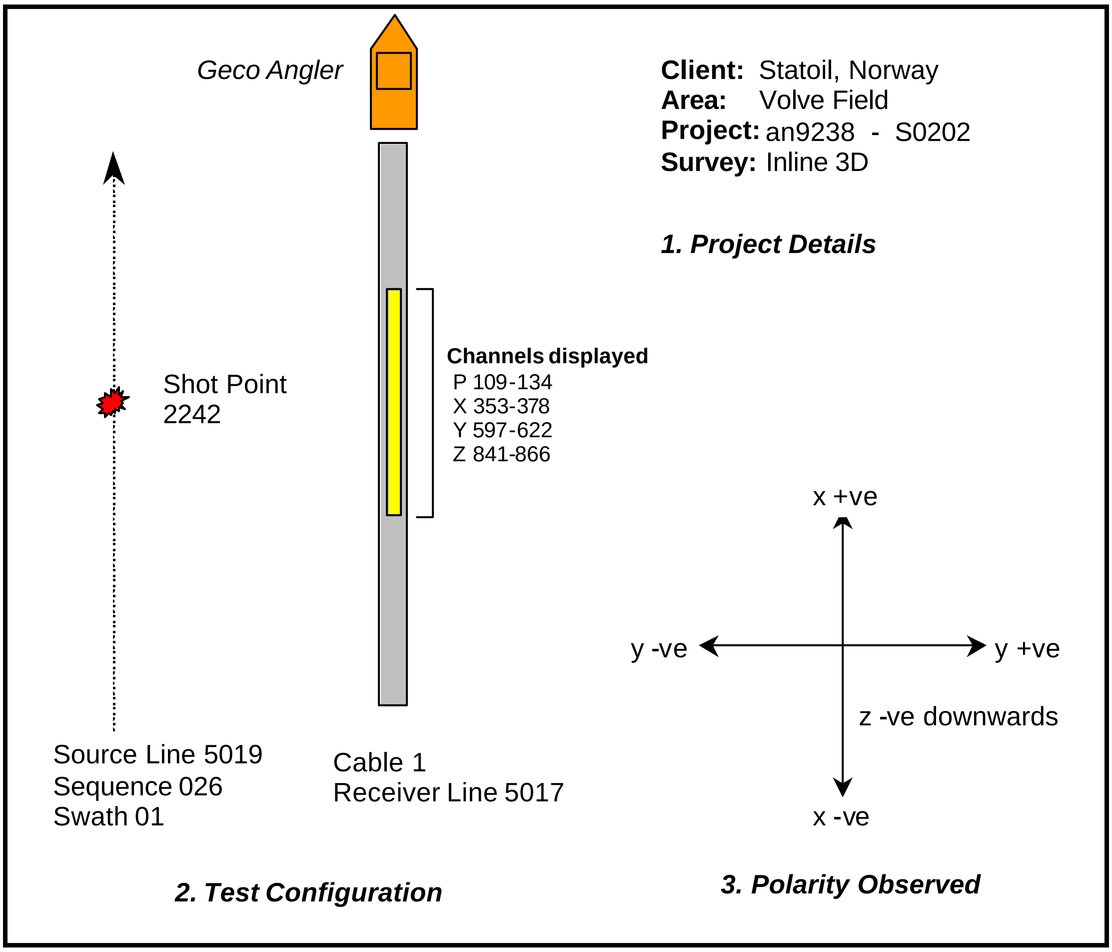


Fig 2. Schematic diagram showing shot selected for parity test.

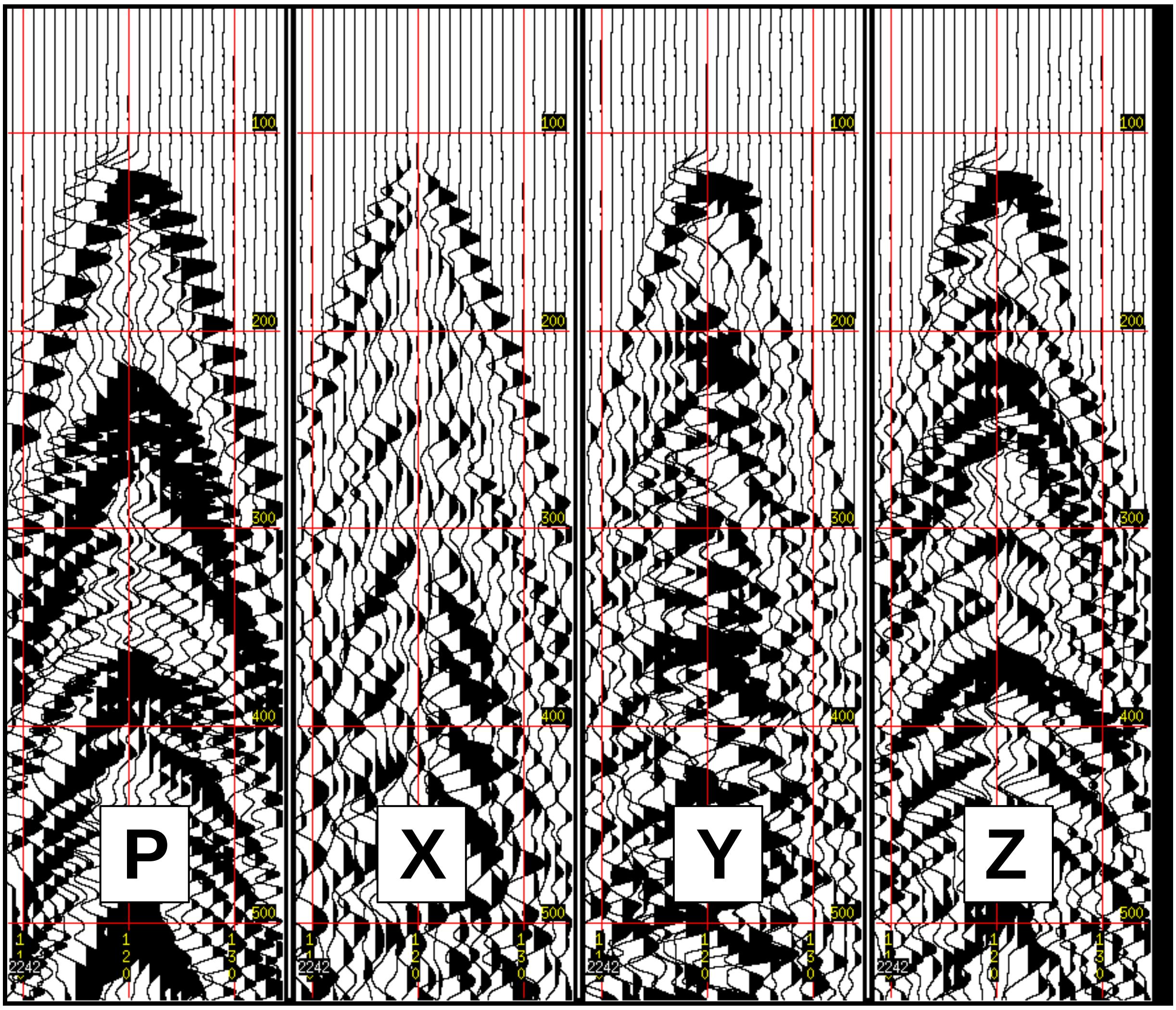


Fig 3. Polarity Test Recorded First Break Data

The diagram above is an illustration of the polarities as observed throughout the survey. (Sequence pictured 026).

The results may be summarised as below.

Component	Negative Amplitude Given By	Convention
P Hydrophone	Positive pressure	SEG
X Geophone	Motion towards tail of cable, away from the recording boat.	Forms with Y and Z a normally oriented Cartesian reference
Y Geophone	Motion towards the port side of the recording boat	Forms with X and Z a normally oriented Cartesian reference
Z Geophone	Downwards motion	Reverse SEG

The tests were in accordance with expectations.

Onboard Processing

25. Onboard Processing Systems

System	Hardware	Software
IBM RS 600 B80	300Gb Useable RAID Discs 4 X 375Mhz CPU 4 Gb memory 4 x IBM 3590 Tape Drives 1 x Monitor	AIX 4.3.3.0 Omega 1.8.1.2

26. Processing Tests and Production Objectives

26.1 Main Onboard Processing Objectives

26.1.1 Geophysical Objectives & Reference Parameters

The main objectives of the seismic survey are to improve the quality of the data compared to conventional surface seismic. The factors to be improved include, multiple attenuation, signal to noise ratio, frequency content and to provide a generally better image of reflectors and faults in the reservoir.

The Volve Field is a complex salt induced dome. The structure is highly faulted with a large variation of reservoir thickness (Hugin Formation) within the faulted sections.

The crest of the structure occurs at 2550 ms two way time.

Thus the main objective of the survey was to improve the structural imaging of the Volve field, thus improving reservoir thickness estimates.

26.1.2 Production Objectives

The main objective of Onboard Processing was to deliver SEGY format seismic tapes with navigation data indented in the headers. At every step of the process, tests were performed to verify the quality of the navigation merge. Navigation SPS files were loaded into the Omega database, survey geometry was built and displays of the individual geometries were made. Positional accuracy of the SPS files was verified by producing LMO plots of common receiver and common shot gathers for each sequence. After the production of merge tapes, stacks of all components were produced to verify the continuity and consistency of the dataset.

Merge tapes were produced almost concurrently with acquisition so that the complete project would be ready for delivery two days after the final completion of the survey.

26.1.3 Survey Details

3D Grid details

Datum:	ED 50
Spheroid:	International
Projection:	UTM
X Origin:	431955.697
Y Origin:	6348582.15
Rotation:	284

Row/Inline grid range 1750-2780 with interval of 12.5 m
Column/Crossline grid range 4960-5220 with interval of 25 m

26.2 Onboard Seismic Parameter Tests

26.2.1 Test Description

No testing was performed on board, apart from revision of basic parameters such as mute to get reasonable stack displays that were used for QC purposes only.

26.2.2 Test Overview

Parameters for gain, predictive deconvolution and muting were based on those selected by QC side. Both departments also used the same single velocity function.
More accurate velocities have been picked every 1000m and have been delivered to DP onshore

27 Processing Production

27.1 Main Seismic Processing Parameters

27.1.1 Pre Stack

- Input SEG-D data and reformat to Omega format
- Set primary processing sort key to shot number and secondary processing sort key to channel number
- Ident seismic trace headers with processed navigation (SPS) data, merge based on time of day, field file number and trace number.
- Indent seismic trace headers with processed depth data.
- Binning of data based on 12.5m x 25m grid.
- Output SEG-Y format 3590 tapes with non-standard labelling (NSL).

27.1.2 PXYZ Brute Stacks

- Input data from Indented SEG-Y Format tapes.
- Apply Acquisition and Trilogy QC edits.
- Select 1 source and 1 cable for QC.
- Apply static correction for recording filter delay (-48.7ms).
- Select PZ & XY components for separate processing streams.
- Sort into CMPs
- Offset selection to 3500m
- Apply correction for spherical divergence (T**2)
- Predictive Deconvolution

P Component:	Operator length 240 ms
Gap:	32ms
Design window:	1600 - 4600 ms
Apply window:	0-8192 ms
Prewhitening:	1.0%

- NMO Correction using regional single velocity function derived

Time(ms)	Velocity(m/s)
0	1480
230	1480
916	1760
1188	1970
1500	2010
1644	2060
1746	2100
2700	2289
3200	2310
5000	2760
7000	3000

- Pre-stack front mute

P&Z Component Outside Mute	
Offset (m)	Time (ms)
100	0
180	200
970	1222
2015	2541
3156	5986
10000	10000

No Tail Mute applied.

- Stack data to 3D volume

- Output stack volume to QCViewer.

27.2 Processing Flow & Quality Control

27.2.1 Main Processing Flow Chart

Input SEG-D data and reformat to Omega Data

|

Merge navigation data based on Time of Day, Field File & Trace Number

|

Binning of data based on 12.5m x 25.0 m grid.

|

Output data to 3590 data cartridge using SEG-Y Standard Format

|

Input data from SEG-Y 3590 Cartridges

|

Apply Acquisition and Trilogy QC edits

|

Select 1 cable, and 1 gun

|

Apply Spherical Divergence Correction

|

Predictive Deconvolution

|

NMO Correction using single velocity function

|

Front Mute

|

Stack data

|

Output stacks to QCViewer display format and QC all components.

27.2.2 Quality Control of Processing Steps

The Navigation department provided final processed SPS navigation files. These files were loaded into the Omega database and as a preliminary QC plots were made showing all shot-point and receiver locations.

A second and more detailed QC of the navigation was also performed. Common receiver and common source gathers were produced and merged with the navigation data.
A linear moveout (LMO) correction using water velocity was then applied to these gathers. See also Trilogy QC report, chapter 3.5 for additional details.

27.3 Navigation QC

For each inline, cable and source positions were QC'd by applying linear move out, LMO, on common shot gathers, CSG, and common receiver gathers, CRG. A flat and continuous LMO corrected water bottom direct arrival indicates a high level of accuracy in the navigational positioning data. To date these procedures have shown to be a highly accurate QC method.

- **Processing sequence:**

1. Collect P component data for CSG and CRG online.	All shots into selected receivers for the common receiver gathers. All receivers into selected shots for the common source gathers.
2. Spherical divergence correction.	Time**2.0, applied 0 - 4000 ms
3. Merge seismic and navigation	Coordinates and water depth
4. Correct range to source-receiver distance	
5. Static shift	+1000 ms
6. Apply LMO	Water velocity
7. Display	

In addition to this, water depth measurements were displayed graphically for all sources and receivers, as a check for erroneous values.
The continuity and ‘flatness’ of the gathers was carefully examined. A flat and continuous LMO corrected water bottom reflection indicated good offset calculation integrity, and would imply a high level of accuracy in positional information. In addition to this, water depth measurements were displayed graphically for all sources and receivers as a check for erroneous echo sounder and processing values.

After verifying the accuracy of the navigation data the positional information was merged with the seismic data using unique time-of-day values as the basis for the merge. This data was then written to IBM type 3590 tapes.
All the tapes were read back into the processing flow, and 2D stacks were produced as a final QC of the merge tapes.

The QC of the navigation data performed by our department plays a key role in the whole operation because it is needed also to check the position of the cables during the acquisition and the swath can be moved only after this QC has been performed

27.3.1 P Stack Volume

- Input data from Idented Omega Format tapes
- Apply edits
- Select P component data with offsets less than 1500m
- Apply Spherical Divergence Correction using T**2 function from 4 – 6000 ms
- Predictive Deconvolution

P Component:	Operator length 240 ms
Gap:	32ms
Design window:	1600 - 4600 ms
Apply window:	0-10240 ms
Prewhitening:	1.0%

- NMO Correction using picked velocity function from rcvline 5065
- Pre-stack front mute

P&Z Component Outside Mute	
Offset (m)	Time (ms)
100	0
180	200
970	1222
2015	2541
3156	5986
10000	10000

- Stack data to 3D volume
- Output stack volume to OmegaVU and to 3590 data cartridge in Omega format.

27.4 Velocity Work

27.4.1 Initial Velocity Field

PZ velocity field was picked onboard in a 1000m x 400m grid on lines having a nominal crossline offset of 50 m.
A single regional velocity function was used for normal move-out correction of the data both in Trilogy QC and OBP.
In OBP this velocity was also used for production of the 'quick look' 3D P stack volume.

27.4.2 Velocity Picking on PZ summed data

PZ Velocity Analysis (performed on single cmp lines above cables)

- Input SEGD data and reformat to Omega format.
- Ident seismic trace headers with processed navigation data, merge based on time of day.
- Ident seismic trace headers with processed depth data.
- Binning of data based on 12.5 m x 25.0 m grid (see above).
- Apply Acquisition and Trilogy QC edits.
- Select P and Z component data having offsets < 3000m
- Wavelet shaping phase filter for hydrophone & geophone before summation
- Apply bulk shift to correct for recording filter delay –48.7 ms
- Redatuming at source level using trace static shift (STATCOR header)
- Constant scaling of Z component to match amplitudes of P component data, scalar = 32

- PZ trace summation using single scalar [H-(-Z)]

- Apply Spherical Divergence Correction.
  T **2 function from 4 – 6000 ms

- Predictive Deconvolution

PZ Component:	Operator length 240 ms
Gap:	32ms
Design window:	1600 - 4600 ms
Apply window:	0-10240 ms
Prewhitening:	1.0%

- Time Variant Bandpass Filter.
  Zero phase, Butterworth bandpass filters.

0 - 2000 ms:	8(18) - 70(72) Hz
2000 - 4000 ms	6(12) - 60(72) Hz
4000 - 6000 ms	6(12) - 50(72) Hz
6000 - 7000 ms	6(12) - 48(72) Hz

- Create velocity analysis. Omega output files using single velocity as starting point: Velocity analysis location every 1000m.

- Velocity picking via Omega IVP

- Output picked velocity set to Omega format files.

27.5 Processing Flow & Quality Control

27.5.1 Main Processing Flow Chart

Input SegD data and reformat to Omega format
|
Ident seismic trace headers with processed navigation data, merge based on time of day
|
Binning of data based on 12.5m x 25.0 m grid.
|
Output data to 3590 data cartridge in SEG-Y Format
|
Input data from Idented Omega Format Packed Cartridges
|
Apply Acquisition and Trilogy QC edits
||
Apply Spherical Divergence Correction
|
Predictive Deconvolution
|
NMO Correction using single velocity function
|
Front Mute
|
Stack data to 2D stack for each component on sequence basis
|
Display and QC stack data

28 Observations

The channels on the Omega tapes are specified as:

Cable	1	2
P Component	5-244 (1)	981-1220 (5)
X Component	249-488 (2)	1225-1464 (6)
Y Component	493-732 (3)	1469-1708 (7)
Z Component	737-976 (4)	1713-1952 (8)

Blue numbers correspond to the channel number and red numbers to the channel set (DIGISEIS_EXCP_BIT)

Some useful header setting on the Omega tapes are specified as:

CABLE COMPONENT	DIGISEIS_EXCP_BITS	FIELD_SENSOR_TYPE	DATA_TRACE_TYPE
Cable 1 P	**1**	**1**	**334**
Cable 1 X	**2**	**2**	**331**
Cable 1 Y	**3**	**3**	**332**
Cable 1 Z	**4**	**4**	**333**
Cable 2 P	**5**	**5**	**334**
Cable 2 X	**6**	**6**	**331**
Cable 2 Y	**7**	**7**	**332**
Cable 2 Z	**8**	**8**	**333**

29 Products & Shipments

Table 1: List of SEG-Y Format Merge Tapes

First Data Shipment (27th June 2002)

Tape List Swath01 Project AN9238DP

Reel No.	Line	Seq. No.	Line	Ffile	Lfile
X01504	0202S01P5023003	**003**	5023	1760	2246
X01505	0202S01P5023003	**003**	5023	2248	2722
X01506	0202S01P5011004	**004**	5011	2728	2242
X01507	0202S01P5011004	**004**	5011	2240	1766
X01508	0202S01P5035005	**005**	5035	1760	2246
X01509	0202S01P5035005	**005**	5035	2248	2606
X01510	0202S01P5003006	**006**	5003	2722	2236
X01511	0202S01P5003006	**006**	5003	2234	1760
X01512	0202S01P5007007	**007**	5007	1760	2248
X01513	0202S01P5007007	**007**	5007	2250	2722
X01514	0202S01P5031008	**008**	5031	2722	2236
X01515	0202S01P5031008	**008**	5031	2234	1760
X01516	0202S01P4999009	**009**	4999	1760	2246
X01517	0202S01P4999009	**009**	4999	2248	2722
X01518	0202S01P5027010	**010**	5027	2722	2236
X01519	0202S01P5027010	**010**	5027	2234	1760
X01520	0202S01P4995011	**011**	4995	1760	2246
X01521	0202S01P4995011	**011**	4995	2248	2722
X01522	0202S01P5039012	**012**	5039	2722	2236
X01523	0202S01P5039012	**012**	5039	2234	1760
X01524	0202S01P4991013	**013**	4991	1760	2246
X01525	0202S01P4991013	**013**	4991	2248	2722
X01526	0202S01P4963014	**014**	4963	2722	2236
X01527	0202S01P4963014	**014**	4963	2234	1760
X01528	0202S01P4987015	**015**	4987	1760	2246
X01529	0202S01P4987015	**015**	4987	2248	2722
X01530	0202S01P5043016	**016**	5043	2722	2236
X01531	0202S01P5043016	**016**	5043	2234	1760
X01532	0202S01P4983017	**017**	4983	1760	2246
X01533	0202S01P4983017	**017**	4983	2248	2722
X01534	0202S01P5047018	**018**	5047	2722	2236

X01535	0202S01P5047018	**018**	5047	2234	1760
X01536	0202S01P4967019	**019**	4967	1760	2250
X01537	0202S01P4967019	**019**	4967	2252	2722
X01538	0202S01P5051020	**020**	5051	2722	2236
X01539	0202S01P5051020	**020**	5051	2234	1760
X01540	0202S01P4979021	**021**	4979	1760	2246
X01541	0202S01P4979021	**021**	4979	2248	2722
X01542	0202S01P4971022	**022**	4971	2722	2236
X01543	0202S01P4971022	**022**	4971	2234	1760
X01544	0202S01P5055023	**023**	5055	1760	2246
X01545	0202S01P5055023	**023**	5055	2248	2722
X01546	0202S01A5015024	**024**	5015	2722	2236
X01547	0202S01A5015024	**024**	5015	2234	1760
X01548	0202S01P4975025	**025**	4975	1760	2246
X01549	0202S01P4975025	**025**	4975	2248	2722
X01550	0202S01A5019026	**026**	5019	2722	2236
X01551	0202S01A5019026	**026**	5019	2234	1760

Tape List Swath04 Project AN9238DP

Reel No.	Line	Seq. No.	Line	Ffile	Lfile
X01554	0202S04P5103027	**027**	5103	1760	2248
X01555	0202S04P5103027	**027**	5103	2250	2722
X01552	0202S04P5071028	**028**	5071	2722	2236
X01553	0202S04P5071028	**028**	5071	2234	1760
X01556	0202S04P5099029	**029**	5099	1758	2244
X01557	0202S04P5099029	**029**	5099	2246	2720
X01558	0202S04P5063030	**030**	5063	2722	2236
X01559	0202S04P5063030	**030**	5063	2234	1760
X01560	0202S04P5095031	**031**	5095	1760	2256
X01561	0202S04P5095031	**031**	5095	2258	2722
X01562	0202S04P5067032	**032**	5067	2722	2236
X01563	0202S04P5067032	**032**	5067	2234	1760
X01564	0202S04P5091033	**033**	5091	1760	2246
X01565	0202S04P5091033	**033**	5091	2248	2722
X01566	0202S04P5087034	**034**	5087	2722	2236
X01567	0202S04P5087034	**034**	5087	2234	1760
X01568	0202S04P5059035	**035**	5059	1760	2248
X01569	0202S04P5059035	**035**	5059	2250	2722
X01570	0202S04P5111036	**036**	5111	2722	2236
X01571	0202S04P5111036	**036**	5111	2234	1760
X01572	0202S04P5079037	**037**	5079	1762	2248
X01573	0202S04P5079037	**037**	5079	2250	2724
X01574	0202S04P5107038	**038**	5107	2722	2236
X01575	0202S04P5107038	**038**	5107	2234	1760
X01576	0202S04P5075039	**039**	5075	1760	2248
X01577	0202S04P5075039	**039**	5075	2250	2722
X01578	0202S04P5115040	**040**	5115	2722	2236
X01579	0202S04P5115040	**040**	5115	2234	1760
X01580	0202S04P5083041	**041**	5083	1762	2248
X01581	0202S04P5083041	**041**	5083	2250	2724
X01582	0202S04P5119042	**042**	5119	2722	2236
X01583	0202S04P5119042	**042**	5119	2234	1760
X01584	0202S04P5123044	**044**	5123	2722	2236
X01585	0202S04P5123044	**044**	5123	2234	1760
X01586	0202S04P5147045	**045**	5147	1754	2246
X01587	0202S04P5147045	**045**	5147	2248	2714
X01588	0202S04P5127046	**046**	5127	2722	2236

X01589	0202S04P5127046	**046**	5127	2234	1762
X01590	0202S04P5151047	**047**	5151	1808	2294
X01591	0202S04P5151047	**047**	5151	2296	2742
X01592	0202S04P5139048	**048**	5139	2722	2236
X01593	0202S04P5139048	**048**	5139	2234	1768
X01594	0202S04P5131049	**049**	5131	2722	2236
X01595	0202S04P5131049	**049**	5131	2234	1766
X01596	0202S04A5143050	**050**	5143	1774	2262
X01597	0202S04A5143050	**050**	5143	2264	2734
X01598	0202S04P5135051	**051**	5135	2722	2236
X01599	0202S04P5135051	**051**	5135	2234	1768

Tape List Swath06 Project AN9238DP

Reel No.	Line	Seq. No.	Line	Ffile Lfile	
X01600	0202S06P5171052	**052**	5171	2722	2236
X01601	0202S06P5171052	**052**	5171	2234	1760
X01602	0202S06P5195053	**053**	5195	1760	2246
X01603	0202S06P5195053	**053**	5195	2248	2722
X01618	0202S06P5175054	**054**	5175	1760	2246
X01619	0202S06P5175054	**054**	5175	2248	2722
X01606	0202S06P5199055	**055**	5199	1760	2246
X01607	0202S06P5199055	**055**	5199	2248	2722
X01608	0202S06P5179056	**056**	5179	2722	2236
X01609	0202S06P5179056	**056**	5179	2234	1760
X01610	0202S06P5203057	**057**	5203	1750	2236
X01611	0202S06P5203057	**057**	5203	2238	2704
X01612	0202S06P5183058	**058**	5183	2722	2236
X01613	0202S06P5183058	**058**	5183	2234	1760
X01614	0202S06P5163059	**059**	5163	1760	2246
X01615	0202S06P5163059	**059**	5163	2248	2722
X01616	0202S06P5139060	**060**	5139	2722	2236
X01617	0202S06P5139060	**060**	5139	2234	1760
X01618	0202S06P5167061	**061**	5167	1760	2246
X01619	0202S06P5167061	**061**	5167	2248	2722
X01620	0202S06P5135062	**062**	5135	2722	2236
X01621	0202S06P5135062	**062**	5135	2234	1760
X01622	0202S06P5159063	**063**	5159	1760	2246
X01623	0202S06P5159063	**063**	5159	2248	2722
X01624	0202S06P5143064	**064**	5143	2722	2236
X01625	0202S06P5143064	**064**	5143	2234	1760
X01626	0202S06A5123066	**066**	5123	1760	2246
X01627	0202S06A5123066	**066**	5123	2248	2706
X01628	0202S06P5147067	**067**	5147	2722	2236
X01629	0202S06P5147067	**067**	5147	2234	1760
X01630	0202S06P5127068	**068**	5127	1760	2246
X01631	0202S06P5127068	**068**	5127	2248	2722
X01632	0202S06P5151069	**069**	5151	2722	2236
X01633	0202S06P5151069	**069**	5151	2234	1760
X01634	0202S06P5131070	**070**	5131	1760	2246
X01635	0202S06P5131070	**070**	5131	2248	2722
X01636	0202S06P5155071	**071**	5155	2722	2236

X01637	0202S06P5155071	**071**	5155	2234	1760
X01638	0202S06P5207072	**072**	5207	1760	2256
X01639	0202S06P5207072	**072**	5207	2258	2722
X04500	0202S06P5187073	**073**	5187	2722	2236
X04501	0202S06P5187073	**073**	5187	2234	1760
X04502	0202S06P5211074	**074**	5211	1760	2246
X04503	0202S06P5211074	**074**	5211	2248	2722
X04504	0202S06B5123075	**075**	5123	2402	2502
X04505	0202S06P5191076	**076**	5191	2722	2236
X04506	0202S06P5191076	**076**	5191	2234	1760
X04507	0202S06P5215077	**077**	5215	1760	2246

2nd Data Shipment (10th July 2002)

Tape List Swath03 Project AN9238DP

Reel No.	Line	Seq. No.	Line	Ffile Lfile
X04508	0202S**06**P5215077	**077**	5215	2247 2272
X04509	0202S03P5087078	**078**	5087	2722 2234
X04510	0202S03P5087078	**078**	5087	2232 1760
X04511	0202S03P5079079	**079**	5079	2722 2236
X04512	0202S03P5079079	**079**	5079	2234 1760
X04513	0202S03P5103080	**080**	5103	1760 2246
X04514	0202S03P5103080	**080**	5103	2248 2722
X04515	0202S03P5099082	**082**	5099	1760 2246
X04516	0202S03P5099082	**082**	5099	2248 2492
X04517	0202S03P5083083	**083**	5083	2722 2236
X04518	0202S03P5083083	**083**	5083	2234 1760
X04519	0202S03A5075084	**084**	5075	1760 2246
X04520	0202S03A5075084	**084**	5075	2248 2722
X04521	0202S03P5107085	**085**	5107	2722 2236
X04522	0202S03P5107085	**085**	5107	2234 1760
X04523	0202S03P5119086	**086**	5119	1762 2248
X04524	0202S03P5119086	**086**	5119	2250 2722
X04525	0202S03A5099087	**087**	5099	2474 2722
X04526	0202S03P5095088	**088**	5095	2722 2234
X04527	0202S03P5095088	**088**	5095	2232 1760
X04528	0202S03P5067089	**089**	5067	1760 2246
X04529	0202S03P5067089	**089**	5067	2248 2722
X04530	0202S03P5043090	**090**	5043	2722 2236
X04531	0202S03P5043090	**090**	5043	2234 1760
X04532	0202S03P5071091	**091**	5071	1760 2246
X04533	0202S03P5071091	**091**	5071	2248 2722
X04534	0202S03P5047092	**092**	5047	2722 2236
X04535	0202S03P5047092	**092**	5047	2234 1760
X04536	0202S03P5063093	**093**	5063	1760 2248
X04537	0202S03P5063093	**093**	5063	2250 2722
X04538	0202S03P5039094	**094**	5039	2722 2236
X04539	0202S03P5039094	**094**	5039	2234 1760
X04540	0202S03P5059095	**095**	5059	1760 2246
X04541	0202S03P5059095	**095**	5059	2248 2722
X04542	0202S03P5027096	**096**	5027	2722 2236

X04543	0202S03P5027096	**096**	5027	2234	1760
X04544	0202S03P5055097	**097**	5055	1760	2246
X04545	0202S03P5055097	**097**	5055	2248	2722
X04546	0202S03P5031098	**098**	5031	2722	2236
X04547	0202S03P5031098	**098**	5031	2234	1760
X04548	0202S03P5051099	**099**	5051	1760	2246
X04549	0202S03P5051099	**099**	5051	2248	2722
X04550	0202S03P5035100	**100**	5035	2722	2236
X04551	0202S03P5035100	**100**	5035	2234	1760
X04552	0202S03P5111101	**101**	5111	1760	2246
X04553	0202S03P5111101	**101**	5111	2248	2722
X04554	0202S03P5091102	**102**	5091	2722	2236
X04555	0202S03P5091102	**102**	5091	2234	1760
X04556	0202S03P5115103	**103**	5115	1760	2246
X04557	0202S03P5115104	**103**	5115	1761	2246

3rd Data Shipment (18th July 2002)

Tape List Swath02 Project AN9238DP

Reel No.	Line	Seq. No.	Line	ffile	lffile
X04558	S0202S02P5051104	104	5011	2722	2236
X04559	S0202S02P5051104	104	5011	2234	1760
X04560	S0202S02P5075105	105	5075	1760	2248
X04561	S0202S02P5075105	105	5075	2250	2722
X04562	S0202S02P5047106	106	5047	2722	2236
X04563	S0202S02P5047106	106	5047	2234	1760
X04564	S0202S02P5071107	107	5071	1756	2246
X04565	S0202S02P5071107	107	5071	2248	2718
X04566	S0202S02A5035109	109	5035	1760	2246
X04567	S0202S02A5035109	109	5035	2248	2722
X04568	S0202S02P5059110	110	5059	2722	2236
X04569	S0202S02P5059110	110	5059	2234	1760
X04570	S0202S02P5007112	112	5007	2722	2236
X04571	S0202S02P5007112	112	5007	2234	1760
X04572	S0202S02P5039113	113	5039	1760	2254
X04573	S0202S02P5039113	113	5039	2256	2722
X04574	S0202S02P5063114	114	5063	2722	2232
X04575	S0202S02P5063114	114	5063	2230	1760
X04576	S0202S02A5031115	115	5031	1760	2248
X04577	S0202S02A5031115	115	5031	2250	2722
X04578	S0202S02P5003116	116	5003	2722	2236
X04579	S0202S02P5003116	116	5003	2234	1738
X04580	S0202S02P5027117	117	5027	1760	2248
X04581	S0202S02P5027117	117	5027	2250	2722
X04582	S0202S02P4999118	118	4999	1760	2236
X04583	S0202S02P4999118	118	4999	2232	2230
X04584	S0202S02B4995122	122	4995	2722	2236
X04585	S0202S02B4995122	122	4995	2234	1760
X04586	S0202S02P5019123	123	5019	1760	2246
X04587	S0202S02P5019123	123	5019	2248	2722
X04588	S0202S02P5043124	124	5043	2722	2236
X04589	S0202S02P5043124	124	5043	2234	1760
X04590	S0202S02P5011125	125	5011	2722	2236
X04591	S0202S02P5011125	125	5011	2234	1760
X04592	S0202S02P5067126	126	5067	1762	2250
X04593	S0202S02P5067126	126	5067	2252	2722
X04594	S0202S02P5015127	127	5015	2722	2236
X04595	S0202S02P5015127	127	5015	2234	1760
X04596	S0202S02A5003128	128	5003	2098	2008
X04597	S0202S02B5023130	130	5023	2722	2232
X04598	S0202S02B5023130	130	5023	2230	1760
X04599	S0202S02A4999131	131	4999	2248	1760
X04600	S0202S02P5079132	132	5079	1760	2248

X04601	S0202S02P5079132	132	5079	2250	2722
X04602	S0202S02P5087133	133	5087	2722	2236
X04603	S0202S02P5087133	133	5087	2234	1760
X04604	S0202S02P5055134	134	5055	1760	2248
X04605	S0202S02P5055134	134	5055	2250	2722
X04606	S0202S02P5083135	135	5083	2722	2236
X04607	S0202S02P5083135	135	5083	2234	1760

Tape List Swath05 Project AN9238DP

Reel No.	Line	Seq. No.	Line	ffile	lffile
X04608	S0202S05P5147136	136	5147	1760	2246
X04609	S0202S05P5147136	136	5147	2248	2722
X04610	S0202S05P5171137	137	5171	2722	2236
X04611	S0202S05P5171137	137	5171	2234	1760
X04612	S0202S05P5143138	138	5143	1770	2258
X04613	S0202S05P5143138	138	5143	2260	2722
X04614	S0202S05P5167139	139	5167	2722	2236
X04615	S0202S05P5167139	139	5167	2234	1760
X04616	S0202S05P5139140	140	5139	1760	2246
X04617	S0202S05P5139140	140	5139	2248	2722
X04618	S0202S05P5151141	141	5151	2722	2236
X04619	S0202S05P5151141	141	5151	2234	1760
X04620	S0202S05P5179142	142	5179	1760	2246
X04621	S0202S05P5179142	142	5179	2248	2722
X04622	S0202S05P5155143	143	5155	2722	2228
X04623	S0202S05P5155143	143	5155	2226	1760
X04624	S0202S05A5131145	145	5131	1902	2400
X04625	S0202S05A5131145	145	5131	2402	2722
X04626	S0202S05P5107146	146	5107	2722	2236
X04627	S0202S05P5107146	146	5107	2234	1760
X04628	S0202S05P5135147	147	5135	1760	2246
X04629	S0202S05P5135147	147	5135	2248	2722
X04630	S0202S05P5111148	148	5111	2722	2236
X04631	S0202S05P5111148	148	5111	2234	1760
X04632	S0202S05P5127149	149	5127	1758	2244
X04633	S0202S05P5127149	149	5127	2246	2712
X04634	S0202S05P5099150	150	5099	2722	2236
X04635	S0202S05P5099150	150	5099	2234	1760
X04636	S0202S05P5123151	151	5123	1760	2250
X04637	S0202S05P5123151	151	5123	2252	2722
X04638	S0202S05P5095152	152	5095	2722	2236
X04639	S0202S05P5095152	152	5095	2234	1760
X04640	S0202S05P5131153	153	5131	1760	1900
X04641	S0202S05P5103154	154	5103	2722	2236
X04642	S0202S05P5103154	154	5103	2234	1760
X04643	S0202S05P5115155	155	5115	1764	2250
X04644	S0202S05P5115155	155	5115	2252	2718
X04645	S0202S05P5091156	156	5091	2724	2234
X04646	S0202S05P5091156	156	5091	2232	1762
X04647	S0202S05P5119157	157	5119	1760	2248
X04648	S0202S05P5119157	157	5119	2250	2722
X04649	S0202S05P5159158	158	5159	2722	2236
X04650	S0202S05P5159158	158	5159	2234	1760
X04651	S0202S05P5175159	159	5175	1760	2252
X04652	S0202S05P5175159	159	5175	2254	2722

X04653	S0202S05P5163160	160	5163	2722	2236
X04654	S0202S05P5163160	160	5163	2234	1760
X04655	S0202S05P5183161	161	5183	1760	2252
X04656	S0202S05P5183161	161	518	2254	2722