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21. Instrumentation, QC and Processing System

Description

System	Hardware	Software
Recording	Input/Output MSX system IBM RS/6000 B80	Version 2
Tape drives	4 each IBM 3590 cartridge	
Plotter	OYO Geospace: 24 inch	
Onboard QC	Seisview via the CRS	Omega 1.8.1
Source Controller	Input/Output Source Synchronisation System	Version 2.1
Auxiliary Systems	WesternGeco Continuous Recording System	Version 4.2
External Header	SEG-D 8058 Format	
Tension Monitor	WesternGeco CTM	
Bird Controller	Digicourse System 3 DMU	Version 4.31

The onboard data quality control functions are performed both online and offline. Seisview was used for online QC displays such as RMS noise analysis, gun pressures/depths display, shot gathers display and areal rms. On-line QC allowed monitoring of data quality in real time and the ability to make immediate decisions if necessary.

The majority of the QC products, less limited by processing time comparatively to on-line processing, were created offline, using the Omega Processing System configured as a small dedicated processing centre with all necessary facilities.
The processing system was connected to the other onboard departments through the vessel network which also provided an easy access to/from onshore processing centre for all required data transfer as well as for onshore support and/or hardware maintenance works. Below is a description of the onboard quality control and processing system instruments.

Off-Line QC System

System	Hardware	Software
OMEGA SPS Onboard Processing (IBM operating System)	IBM RS/6000 B80s • 1.00 TBytes data disk 2 × Tektronics work stations 1 × 36” OYO plotter	OMEGA version 1.8.3
EMASS Silo Tape System PC EMASS (OS/2 operating system)	16 × 3590 Tape drives connected to SILO.	

22. Instrumentation and QC Tests

22.1. Semi-Monthly 16 Feb 05

SemiMonthly Test Results 16-Feb-05

Cable	Location	SG	Trace	Channel	File 1001	File 1002	File 1003	File 1004	File 1014	File 1015	File 1016	File 1017	File 1018	File 1019	File 1020	File 1021	File 1022	File 1023	File 1025
					T13	T13	T13	T13	T2 @ -90 dB DRD 4%	T2 @ -100 dB DRD 4%	T5 Pre-Amp Noise	T10 Common Mode .7250	T11 Cross-Feed (odd) <2.3 mv	T12 Cross-Feed (even) <2.3mv	T 6 Impulse response 2Hz	T7 Impulse Response 8/18	T7 Step Function 8/18	T4 DRD 8/18	T0 Cable Noise 8/18
					All Ones	50/50	All Zeros	Sine 15.625 Hz	+/- 4.0%	+/- 4.0%	< .210 uB	<66dB FS	<56dB FS	<56dB FS	+/- 7.0%	+/- 7.0%	+/- 7.0%	+/- 7.0%	
1																			
	11a	SG	168	168									388.168						
	11b		169	169										23.352					
	16a		243	243												275.61	40.29	72.670	
2																			
	6b		475	91								0.762							
	9a		519	135												143.77			
	9a	SG	520	136													10.97	31.276	
	9b		526	142												180.49			
	9b	SG	528	144												148.30			
	10b		543	159												11.92	11.68		
	11b		553	169										421.194				12.678	
	11b		554	170										2217.602		11.49	57.36	37.939	
	11b		555	171									299.502			70.67	86.39	66.943	
	12a		564	180												116.96			
	12b		574	190												133.69			
	15a	SG	616	232									12.986						
	16a		627	243													12.41	56.458	
	18a		661	277													11.54		
3																			
	5b		841	73												124.25			
	10a		919	151												10.32	10.26		
	12b		953	185										34.143					
	12b		959	191									40.212						
	16b		1023	255												10.05	10.14		
	23a		1124	356													17.97	59.959	

4																			
	3b		1194	42												155.38			
	3b		1196	44												107.03			
	3b		1199	47												299.23			
	7b		1257	105														20.525	
	9b	SG	1296	144									105.881						
	10a		1297	145										80.032			27.17		
	10a		1298	146										20.696			11.60		
	10a		1299	147												190.04			
	10a		1300	148													10.62		
	10a		1301	149													10.14		
	10a		1302	150										25.535			11.04		
	12b		1338	186										177.897					
	12b		1340	188									175.758						
	14b		1372	220												136.06			
	16b		1407	255									14.808						
	20a		1462	310												11.48	11.45		
	24b	SG	1536	384									9.003						
5																			
	4a		1588	52												136.43			
	7b		1641	105												195.20			
	8b		1660	124									18.547						
	8b		1661	125										26.943					
	9b	SG	1680	144												130.48			
	13a		1733	197												281.01			
	17b		1806	270												17.38	17.30	11.803	
	19a		1826	290										25.642					
6																			
	4b		1978	58												114.34			
	6a	SG	2008	88												16.90	16.96	18.132	
	24b	SG	2304	384													11.32	25.136	
7																			
	4b		2367	63												30.32			
	6a		2390	86												152.80			
	12a	SG	2488	184												10.55			
	16a		2548	244									9.932						
	16a		2550	246										137.627					
	16a		2551	247									104.805						
	18b		2588	284												60.74	60.76	62.167	
	22b	SG	2656	352									24.218						
8																			
	11b		2860	172									19.515						
	11b		2861	173										25.658					
	14a		2903	215												202.86			

22.2. Daily Tests

	Oscar (9439)				Reel #: V30721		seq 9		February 19, 2005	
Cable	**Location**	**SG**	**Trace**	**Channel**	**T2 @ 0 dB +/- 0.0005%**	**T2 @ -60 dB +/- 0.5%**	**T5 Noise**	**T6 Impulse +/- 7.0 %**	**T4 DRD +/- 10.0 %**	**T7 Impulse +/- 10.0 %**
1										
	16a		243	243					72.819	274.24
	18a		274	274						
	18a		275	275						
2										
	2b		413	29						
	5a		452	68						
	9a	SG	520	136					21.204	
	10b		543	159						10.56
	11b		553	169					16.010	
	11b		554	170					31.480	
	11b		555	171					66.850	74.06
3										
	4a		822	54						
	12b		959	191						
	23a		1124	356					25.600	14.2
4										
	5a		1220	68						
	7b		1257	105					20.600	
	10a		1297	145					38.800	10.3
	10a		1298	146					21.900	
	10a		1302	150					16.750	
	20a		1462	310						11.82
5										
	17b		1806	270					11.603	16.8
6										
	6a	SG	2008	88					18.133	17.29
	10a		2065	145						
	24b	SG	2304	384					22.651	
7										
	1a		2305	1						
	2b		2332	28	0.00082					
	18b		2588	284						
8										

	Oscar (9439)				Reel #: V30848		seq 28		February 24, 2005	
Cable	Location	SG	Trace	Channel	T2 @ 0 dB	T2 @ -60 dB	T5 Noise	T6 Impulse	T4 DRD	T7 Impulse
					+/- 0.0005%	+/- 0.5%		+/- 7.0 %	+/- 10.0 %	+/- 10.0 %
1										
	16a		243	243					72.300	274.24
	18a		274	274						
	18a		275	275						
2										
	2b		413	29						
	5a		452	68						
	9a	SG	520	136					16.500	
	10b		543	159						10.56
	11b		553	169					16.010	
	11b		554	170					31.480	
	11b		555	171					65.800	74.06
3										
	4a		822	54						
	12b		959	191						
	23a		1124	356					25.600	14.2
4										
	5a		1220	68						
	7b		1257	105					20.600	
	10a		1297	145					38.800	10.3
	10a		1298	146					21.900	
	10a		1302	150					16.750	
	20a		1462	310						11.82
5										
	17b		1806	270					11.603	16.8
6										
	6a	SG	2008	88					18.133	17.29
	12b		2106	186	0.00050					
	24b	SG	2304	384					22.651	
7										
	1a		2305	1						
	2b		2332	28						
	18b		2588	284						
8										
	19b		2989	301						

22.3. Semi-Monthly 1-March-05

SEMIMONTHLY TEST 1-MAR-2005

					File 1005	File 1013	File 1014	File 1015	File 1016	File 1017	File 1018	File 1019	File 1020	File 1021	File 1022	File 1023	File 1025
Cable	Location	SG	Trace	Channel	T2 @ 0 dB Harmonic Distortion	T2 @ -80 dB Harmonic Distortion	T2 @ -90 dB DRD 4%	T2 @ -100 dB DRD 4%	T5 Pre-Amp Noise	T10 Common Mode .7250	T11 Cross-Feed (odd) <2.3 mv	T12 Cross-Feed (even) <2.3mv	T 6 Impulse response 2Hz	T7 Impulse Response 8/18	T7 Step Function 8/18	T4 DRD 8/18	T0 Cable Noise 8/18
					< 0.0005%	< 5%	+/- 4.0%	+/- 4.0%	< .210 uB	<66dB FS	<56dB FS	<56dB FS	+/- 7.0%	+/- 7.0%	+/- 7.0%	+/- 7.0%	
1																	
	11a	SG	168	168							96.395						
	11b		169	169								77.545					
	16a		243	243										273.77	39.49	72.231	
2																	
	6b		475	91						0.762							
	9a	SG	520	136											9.68	17.735	
	10b		543	159										11.35	11.12		
	11b		553	169								284.375				12.100	
	11b		554	170								1792.018				13.040	
	11b		555	171							2125.233					11.989	
	13b		589	205								9.431					
	15a	SG	616	232							13.022						
3																	
	10a		919	151										10.90	10.95		
	12b		953	185								64.813					
	11b		943	175							18.202						
	12b		959	191							86.518						
	13b	SG	976	208							10.450						
	14a		978	210								10.135					
	16b		1017	249										10.25	10.12		
	16b		1023	255										9.19			
	23a		1124	356											12.17	38.085	

4																	
	7b		1257	105											11.88	33.700	
	9b	SG	1296	144							89.624						
	10a		1297	145								67.036		11.39	18.36	38.525	
	10a		1298	146								32.909				16.521	
	10a		1302	150								33.127			10.69	22.833	
	12b		1338	186								66.573					
	12b		1340	188							65.188						
	16b		1407	255							16.122						
	20a		1462	310										11.33	11.25	9.050	
	23b		1518	366										9.13			
	24b	SG	1536	384							9.930						
5																	
	10a		1687	151										9.55	9.54		
	10b		1692	156										9.92			
	17b		1806	270										17.96	17.88	13.212	
	19a		1826	290								29.023					
	21a		1859	323												9.210	
6																	
	6a	SG	2008	88										17.11	17.15	18.171	
	8b		2047	127										11.26	11.03		
	12b		2106	186	0.000503												
	24b	SG	2304	384											11.58	26.793	
7																	
	12b		2490	186										9.21	9.32		
	12b	SG	2496	192										9.83			
	16a		2546	242								16.602					
	16a		2550	246								54.419					
	16a		2551	247							110.062						
	22b	SG	2656	352							23.658						
8																	
	11b		2861	173								39.394					

22.4. QC Tests

22.4.1. Gain Correction Test.

The Gain correction method, determined by tests conducted at the beginning of Moby survey, was implemented for the Oscar survey: only geospread compensation based on a single velocity function, was applied to brute stack and water bottom cube data..
The single velocity function, used for Geospread Compensation and NMO correction is presented below.

Single Velocity Function used for Geospread Compensation and Normal Move Out Correction:

TIME(ms)	Velocities (m/s)
0	1500
75	1500
300	1900
600	2250
1200	2600
2000	3200
3300	4400
5000	5400

23. QC Products and Processing Sequence

For on-line QC analysis seismic data was re-sampled to 4 ms.
Seismic data for off-line QC analysis had 2 ms sample rate.
Water Bottom Cube also was produced with 2 ms sample rate.

23.1. Shots and FK Analysis

Shot records were displayed **online** by rotating cable/source combinations. Paper plots were also produced for every 113th shot during the line to check noisy and spiking channels, swell noise, seismic interference and other types of noise encountered.
This helped to identify noise sources and QC data outside the windows used for Attributes analysis.

Shot records were also displayed offline within the Omega Processing System. Every 105th shot, all cables were written to a QCViewer file that could be displayed on screen for identifying noisy traces and interference.
For the same shots FK analysis was performed. FK displays were used as an extra tool helping to identify the different kind of noise that could affect seismic records.

For every line Shot and FK displays of the first good shot point were saved in gif format.

23.2. RMS Analysis

23.2.1. Deep and Ambient RMS Windows

Deep window RMS values were calculated in a time window from 4500 – 5000 ms of the records.
RMS values were calculated for every trace, each shot.
Ambient window RMS values were calculated in a time window from 500 – 1000 ms.
The calculation was performed for the last 100 filed channels of each streamer.

Processing Sequence

1.	Data Input:	Deep RMS: All shots, all channels, window 4500 - 5000 ms. Ambient RMS: All shots, field channels 285 - 384, window 500 - 1000 ms.
2.	Scaling:	By 71.428571 to convert amplitudes to microbars.
3.	Raw RMS Analysis:	One trace is output for each shot containing the RMS amplitude over the window for each selected channel: Deep RMS analysis: field channels 1 – 384; Ambient RMS analysis: field channels 285 – 384; Minimum phase low pass filter at 8 Hz 18 dB/Oct was applied.
4.	Low Frequency RMS Analysis:	One trace is output for each shot containing the RMS amplitude over the window for each channel. Minimum phase low pass filter at 8 Hz 18 dB/Oct was applied.
5.	Mid Frequency RMS Analysis:	One trace is output for each shot containing the RMS amplitude over the window for each channel. Minimum phase band pass filter was applied: Low cut 8 Hz 18 dB/Oct; High cut 70 Hz 72 dB/Oct.
6.	High Frequency RMS Analysis:	One trace is output for each shot containing the RMS amplitude over the window for each channel. Minimum phase low cut filter at 70 Hz 72 dB/Oct was applied.

23.2.2. RMS Displays

The output analysis generated various displays, allowing analysing the level of noise for each channel for entire sail line in different frequency bands, to identify noise source (sometimes with combination of information from Shot display and/or BSTK), to detect bad channels and detect or confirm shots, affected by external or electrical noise.

The first three displays, described below, are based on the same Raw Deep RMS data.
The reason to produce all of them is that each of them better highlight some of the events that may be difficult to be spotted or measured on other plots.
The fourth display combines data, measured in different time windows and in different frequency diapasons.

Arial RMS display. Represents channel numbers versus shot points with colour-coded RMS values; shows signal amplitude in microbars.
This display gives a general overview of noise level through the sail line and allows determination of noisy or dead channels, as well as noisy shots.

The display was produced both **on-line** with Raw RMS data (2 Hz / 12 dB/Oct LCF) and **off-line** with both Raw RMS data (2 Hz / 12 dB/Oct LCF) and Mid-High Frequency data (8 Hz 18 dB/Oct LCF).

Average RMS values of each trace for the entire line. This Display helps to identify noisy, weak, and dead traces. The display was produced **off-line** for the Deep Analysis window for Raw RMS data (2 Hz / 12 dB/oct LCF).

Average RMS values of each cable versus Shotpoint. This Display was generated in order to identify noisy areas throughout the sail line; to detect shots, affected by electrical noise (example: telemetry error), direction of any interfering external noise.
The display was produced both **on-line** and **off-line** with Raw RMS data (2 Hz / 12 dB/Oct LCF).

Bandpass Average Deep and Ambient RMS values versus Shotpoint. For each shot RMS values were averaged and plotted versus Shotpoint. Correspondingly to 23.2.1, five graphs were presented on display: Raw Deep, Low frequency, Mid frequency and High frequency Deep RMS, Raw Ambient (consisting of a the last 100 traces of each cable over a window of 500-1000ms).
A possibility to observe and analyse together the RMS, registered in different time and frequencies windows, helps to identify the cause of noise and separate the real noise, particularly swell noise, from noise, caused by geological events (strong seismic signal at deep times).
This display was produced **off-line**.
An **on-line** modification produced only a pair of Raw Deep RMS and Raw Ambient RMS as a main identifier of the level of swell noise.

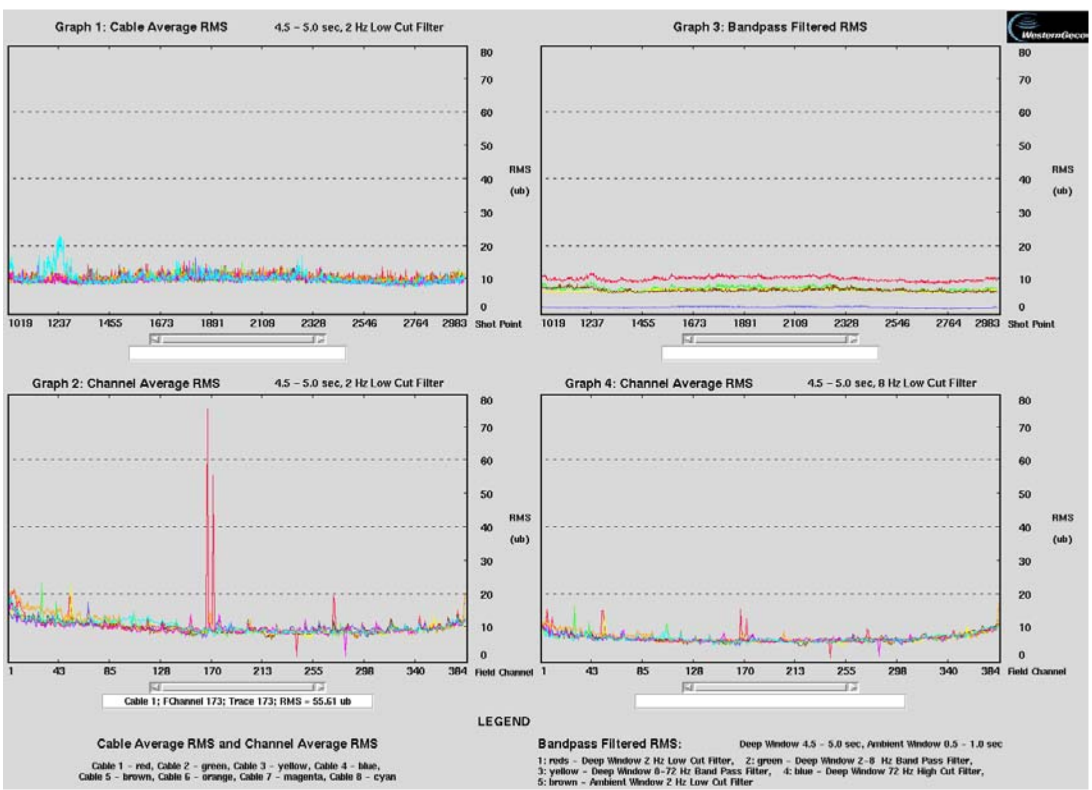

Figure 1. RMS Attributes Display. Sequence 001.

GIF files were created for this off-line RMS display and delivered to a client's representative on-board. These were also uploaded to the Supervision server in Oslo to allow for client viewing from ashore.

23.3. Bad Traces Editing

Analysis of Shots and RMS data allowed us to identify bad traces to write into two different Edits Files.

Zeroed, distorted, noisy and weak traces were identified as bad and included in the acquisition log as edits. Any shots with parity or Telemetry errors were identified and noted in the acquisition log as a shot edit for that streamer.

All shots affected by misfires, low or high pressure, or shots where synchronisation error exceeded 1.25 ms for any gun, also were added to the Edits File.

In addition, extra traces that fell out of depth specification were detected from P1/90 and output into a text file in a form “Shotpoint” – “Trace”.
These depth edits also were added to a “bad traces” file.
To be able to visualize the depth edits text file and final edits file for better inspection a plot Traces vs Shotpoints with colour-coded depth were produced for each line (figure 2).

Finally, all edits from “bad traces” file also were produced as a plot Traces vs Shotpoints (figure3).
These plots were presented to client’s representatives on board.

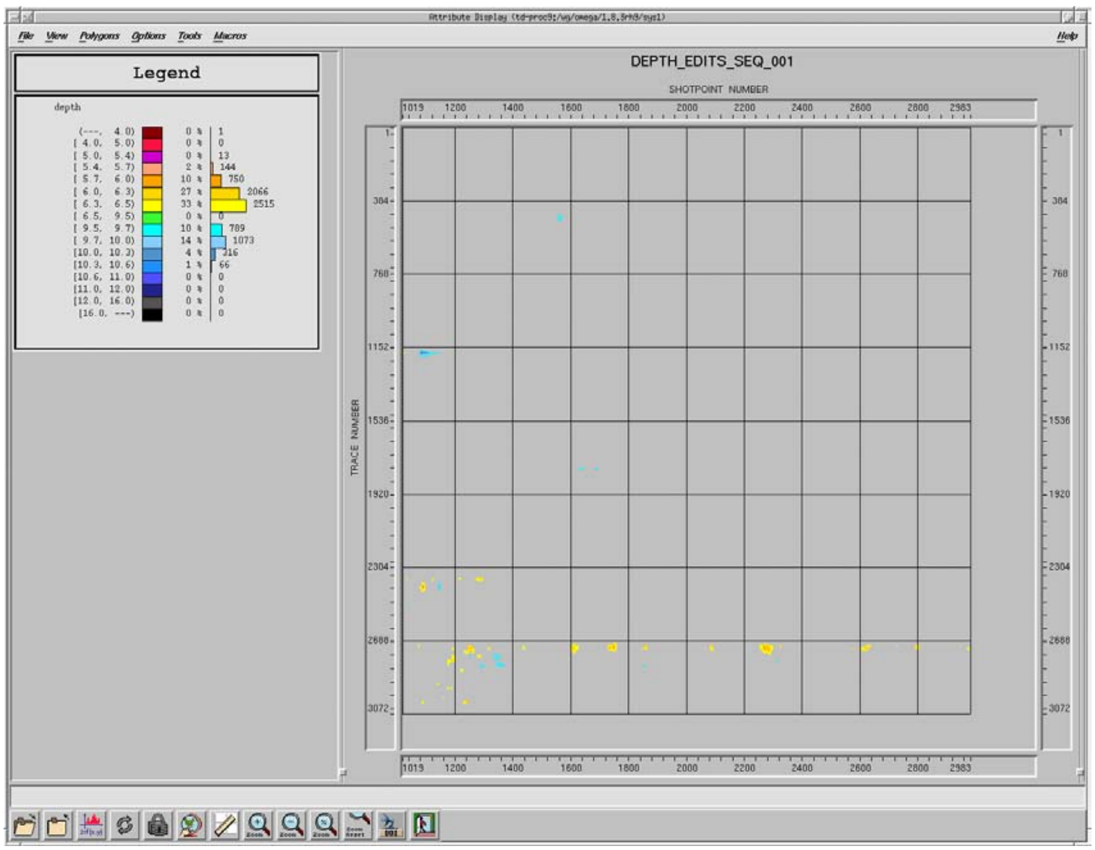

Figure 2. Depth Edits Display. Sequence 001.

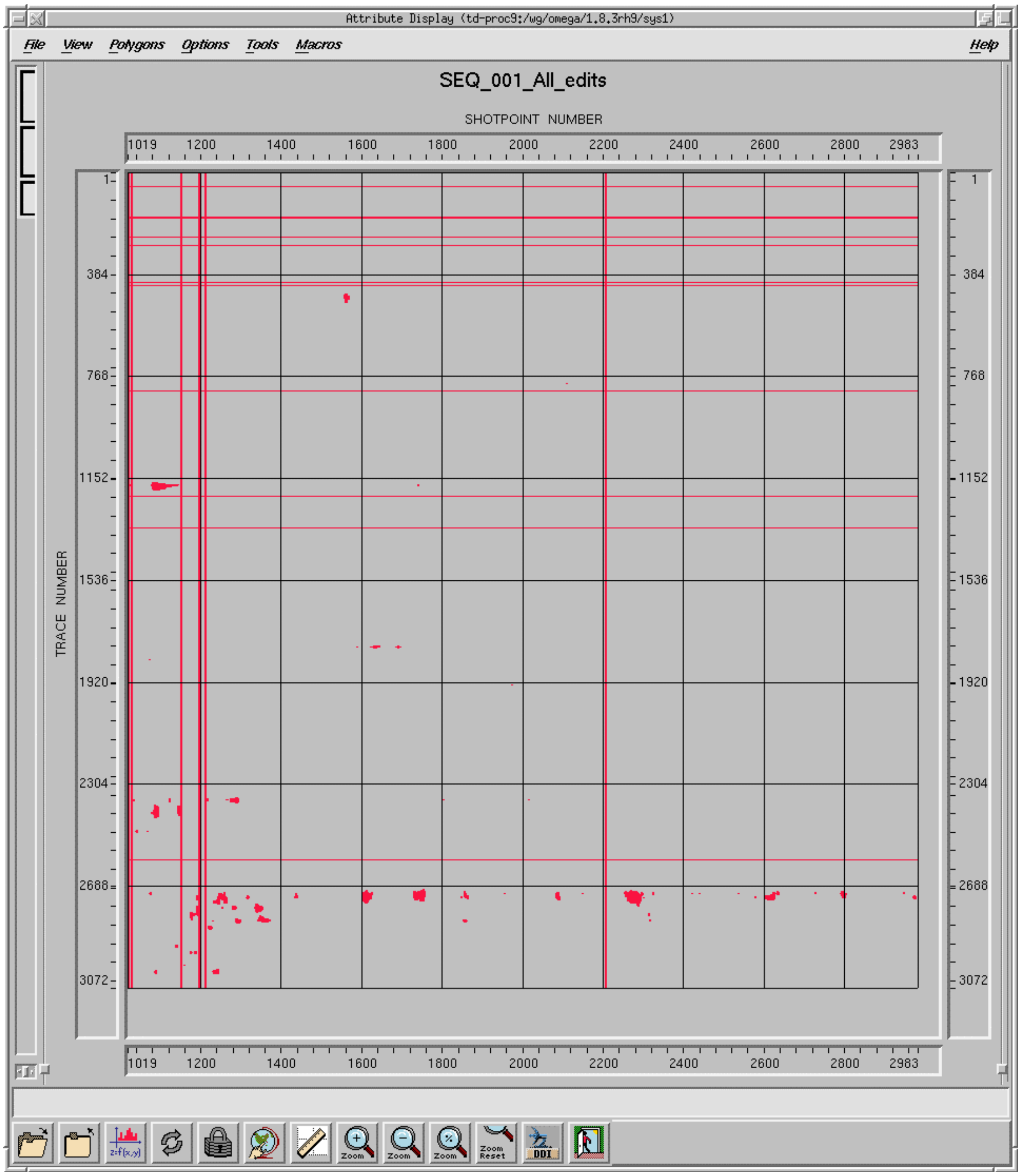

Figure3. All Edits Display. Sequence 001.

23.4. Near Trace Display

As part of the quality control process, near trace data with streamer rotation per sail line were selected for every sail line acquired. The first second of data was displayed to allow for detection of autofires. These were displayed using QCViever and gif files were delivered to the onboard client and uploaded to the Supervison server in Oslo.

Processing sequence:

1. Collect near traces :	Field channel 9, selected source (Port or Starboard) and streamer combination.
2. Bandpass frequency filter	Low cut filter 2 Hz. 12dB/oct
3. Gain recovery: - Geospread compensation; - Exponential Gain Correction	Geospread compensation using the single velocity function (for velocity function see 22.4.1) -- Exponential gain correction: 4 dB/sec, window length 2000 ms, start time 2000 ms
4. Output to QCV Display :	Scale: horizontal = 35 traces/cm: vertical=23 cm/sec.

23.5 Source Attributes

Source analysis of each substring was performed for every line to determine possible air leakages and any drop in source energy, detect the sources depth and guns firing time.
Header information was read from a single trace to detect the required information.
Correspondingly, three attribute displays were produced on-line and off-line:

- guns pressure vs shotpoint for each bundle (one sensor per substring);
- guns depth vs shotpoint for each bundle (three sensors per substring);
- guns firing time vs shotpoint for each gun.

Additionally, an attribute display with sources comparison information was produced off-line.
For comparison, 50 near traces from two inner streamers (streamers 4 and 5) were extracted.
For these traces for every shot RMS was calculated in the time window from Water Bottom Time + 500 ms to Water Bottom Time + 3000 ms. The values, represented averaged values for Port and Starboard sources and their difference, were produced for every shotpoint (figure 4).

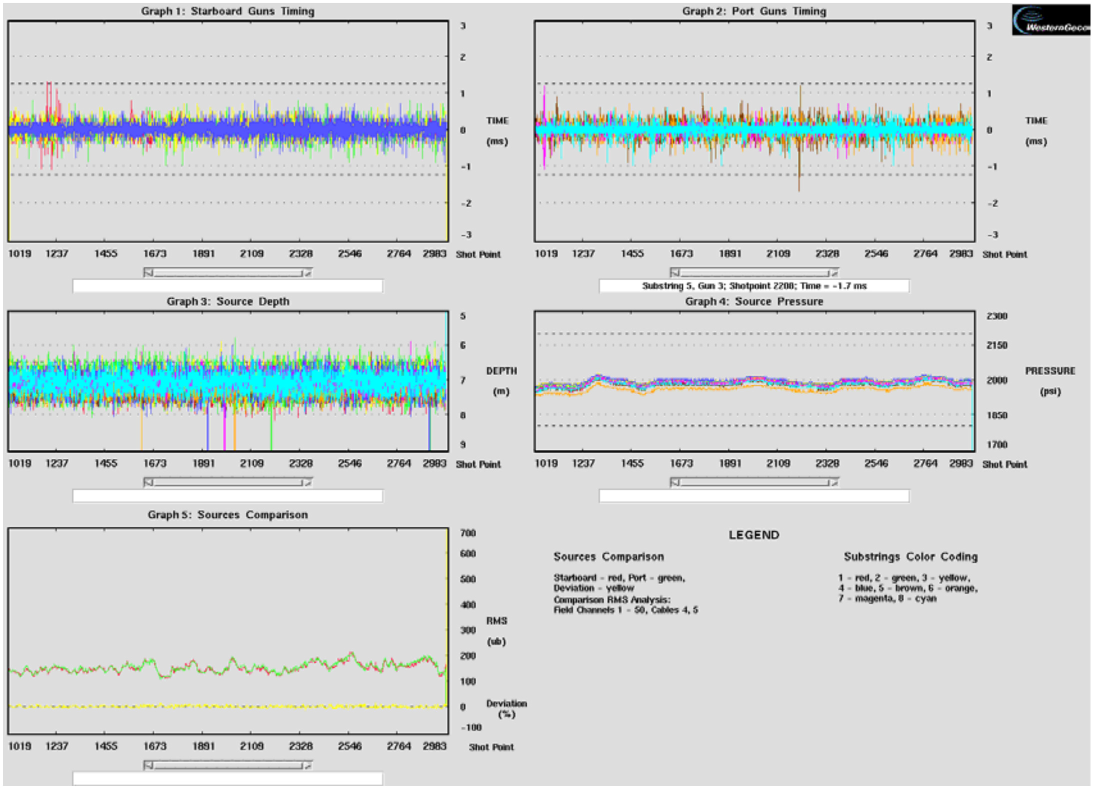

Figure 4. Sources Attribute. Sequence 001.

23.6 Brute Stack

For each sail line a different source / streamer combination was used to generate a brute stack for one subsurface CMP line.
On-line Brute Stack. A real time Terminal display was generated for every line. It involved selection of every second trace. At the end of the line acquisition, the QC group was able to generate paper plot with brute stack, if necessary. This intended to give a much faster guide in identifying the extent of external noise in the data acquired until a full off-line brute stack was produced later.
Off-line Brute Stack was generated after bad shots and traces, derived from shots / RMS analysis, were removed from processing sequence.
A GIF file of Brute Stack was created for every line and placed in Supervision.
A paper plot also was generated for every line for QC purpose.

The water bottom dependent velocity function was supplied by client in a form:

Velocity	Depth
1500	0
1500	WB
1800	WB + 350
2300	WB + 700
4770	WB + 5000

It was calculated for water bottom two way travel time 100 ms and 500 ms and loaded in Omega format. The velocities for water bottom between 100 and 500 ms were linearly interpolated.

Processing sequence:

	OFF-LINE	**ON-LINE**
Input 1 CMP line per sail line	384 channels	128 channels (3:1 traces decimation).
Line edits applied	Delete bad shots/traces derived from Observers Log file and form shots / RMS analysis	Delete spiky / noisy traces, determined from previous lines
Gain Recovery	Geospread Compensation	Single Velocity Function
Low Cut Minimum Phase Frequency Filter	3 Hz 18 dB/Oct	3 Hz 12 dB/Oct
Nominal Marine Geometry	2D geometry using nominal offsets Group Interval 12.5 m	Group Interval 37.5 m
Adjacent Traces Summation (2:1) with Differential Move Out Correction	Water bottom dependent Velocity Function	Not Applied
Nominal Marine Geometry	2D geometry using nominal offsets. Group Interval 25 m	
Predictive Deconvolution.	Operator length 300 ms; Gap 36 ms.	Not Applied
Normal Move Out Correction	Water Bottom Dependent Velocity Function	

Pre-stack Outside Mute with offset/time pairs:	Water Bottom time (ms)	Distance(m)	Time(ms)
	100	400	125
		650	500
		1500	1400
		2400	2500
		3200	3400
		4500	4300
		5100	4600
	350	400	125
		650	935
		1325	1800
		2600	3000
		3700	3700
		5100	4600

Stack Root N scaling	64 fold for single boat operation (dual source) 128 for undershoot lines (single source)	

Output	To disk file in OMEGA format	
Output	To disk file in SEGY format	Not Applied
Trace scaling	Window length 1000 ms 50% overlap. (applied only to a screen output)	Window length 5000 ms
Screen Output	Output to QCV file for QCViewer	Output to a Terminal Display
Output to Paper Plot	36" OYO Plotter 20 traces/cm 10 cm/sec	Not required for this project

23.5. First Break QC (P190 QC) Display

The main purpose of this QC tool is to confirm the positioning of the source and near trace of each cable within the P190. This is done by calculating the distances between the source and the near trace of each cable using the x-y coordinates in the P190. Using this distance and a water velocity of 1500 m/s, a calculated time is derived from the equation distance = velocity x time. This calculated time, or navigation spike, was superimposed onto the seismic trace and shifted 70ms earlier so that it could be compared from SP to SP. An incorrect source position in the P190 would be represented by a shift of roughly 10-30ms or 80-100ms depending on which streamer was being viewed. If this occurred, it was obvious by the way the traces were displayed for QC purposes and that SP was edited. The other purpose of this QC tool is to check the consistency of the navigation network from shot to shot. Any slight movements in the navigation spikes could represent a weak network solution if proportional movements are not seen with the first breaks of the seismic trace.

Field channel number 3 from each streamer was selected. As soon as the final navigation data (P190) was available, the near traces were merged with the processed navigation data. The x / y source and receiver positions were written to the trace headers and analysed.

1. Collect near traces :	Select field channel 3 from each cable
2. Geometry update	Merge selected traces with final P190 headers. A shift of 70 ms was used to offset seismic and navigation data prior to display.
3. Truncate data	Truncate data below 420 ms.
4. Display	Display seismic and navigation data for each subsurface line. Data was output to disk in CGM format, and also viewed via QCviewer interactive display.

23.7 Water Bottom Cube

The main purpose of this QC tool is to check for erroneous positioning during the acquisition by analysis of in-line, cross-line, and time-slices plots.
The seismic and navigation data were merged after final navigation P190 data was available. The x / y source and receiver positions were written to the trace headers. This information was then used to assign true offsets, select traces with offset between 430 and 490 m., and grid the selected near traces.
The processing flow included:

- Input selected traces,
- Bad traces/shot edited,
- Progressive stack file created,
- Geospread compensation using Water Bottom Dependent Velocity Function
  NMO (normal moveout) corrected using the same velocity function
- Writing into OmegaVu cube for visual inspection on screen and on paper plots.

Cube Parameters:

Inlines	: 988 - 1684	Increment:	1
Crosslines	: 841 - 3101	Increment:	1
Cell Size	: 18.75 m x 25.00 m		
Rotation	: 95.785 degrees		
Corners Coordinates			
988 / 841	: X = 656348.97 Y = 5776480.04		
988 / 3101	: X = 698508.17 Y = 5772208.82		
1684 / 841	: X = 654595.13 Y = 5759168.66		
1684 / 3101	: X = 696754.32 Y = 5754897.43		
Data Length	: 1400 ms.		
Sample Rate	: 2 ms.		

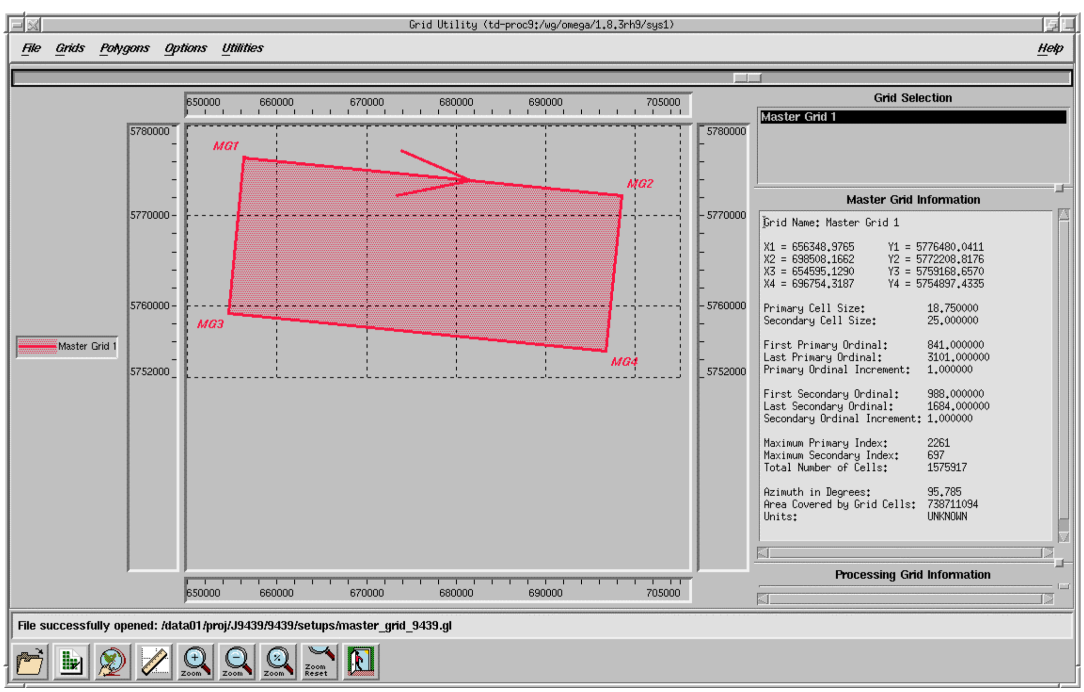

Figure 5. The Grid used for Water Bottom Cube.

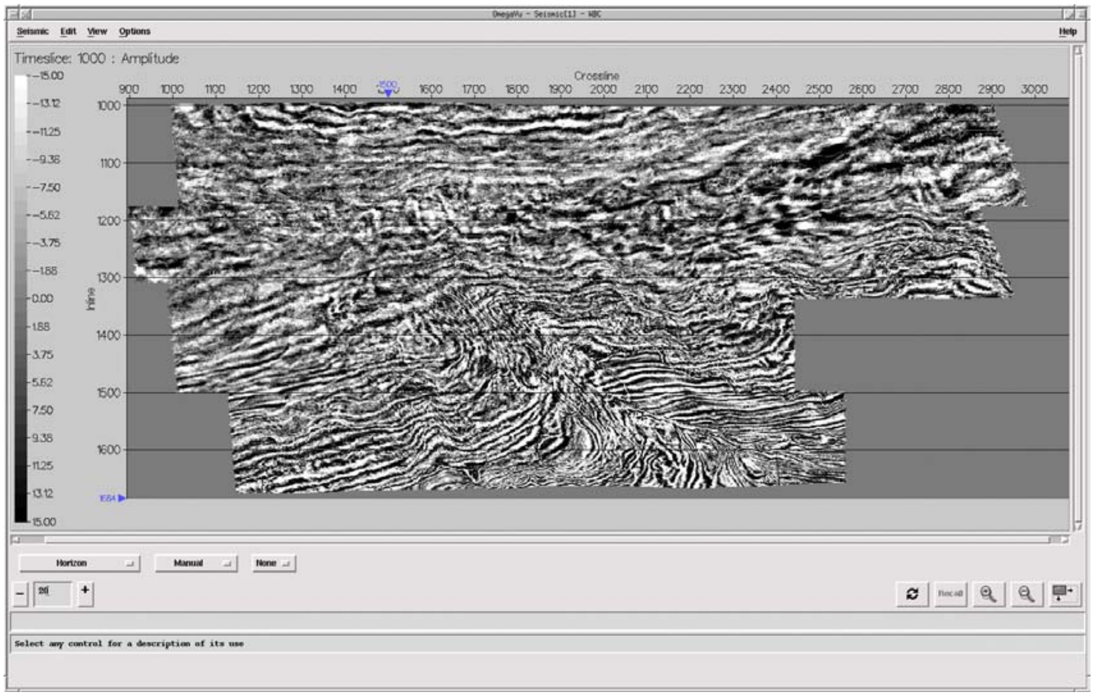

Figure 6. Water Bottom Cube. Time Slice at 1000 ms.

24. Data Quality / Observations

24.1 Quality Control Summary

24.1.1 QC Outputs

A significant number of plots and displays were produced for quality control of each sequence, allowing rapid and accurate delineation of noise types and their associated effects on data quality. A dedicated local disk directory was provided so that gif files of these displays were provided regularly after end of each acquisition line for the onboard client to evaluate. Most of the products were created offline, but a chosen number of displays were generated online in order to provide a much quicker appraisal of the data quality, using Shot display, Brute Stack display, attributes such as RMS noise level, source pressure, depth for each string. Also a gun timing display presenting firing time versus Shotpoint for each gun was produced in real time and off-line.
RMS analysis on deep and ambient windows provided very useful information for the client and crew in determining the amount of swell noise, ship's noise and other types of noise present in the data.
Analysis of RMS level for each channel, averaged for the entire line, helped to identify noisy or weak channels.

Shot gathers were plotted on the OYO plotter with an interval of 2118 metres (every 113th shot, for different cable/source combination), which were being checked by the acquisition group.
In addition, shot records were output offline every 105^{rth} shot which were viewed through Omega QCviewer to identify noisy channels and electrical spikes. FK analysis was performed on these shots. A RMS source comparison was performed on every sequence to identify any serious problems with the source output.

As an extra quality control, allowed to visualise depth edited traces, (8m target streamers depth, +/- 1.5 m allowed depth variations), two Attribute Displays were produced:

- Depth edited traces versus Shotpoint with colour-coded depth;
- All edits versus Shotpoint.

The visualisation of text files allowed to observe and analyse the edited areas much more easier.

The monitoring of quality of navigation data was performed by producing First Break QC plot and by analysis of cross-lines, in-lines, time-slices of Water Bottom Cube.

24.1.2 Noise encountered

- **Swell Noise**

This kind of noise started affecting data from the end of line 1600J1 (sequence 037). Streamer 8 at the end of line sequence 037 was mostly edited out due to shallow position.
At some degree the swell noise affected all lines up to sequence 046.
The SWATT test was running on the worst data, e.g. sequence 037 and 045. The results showed that the noise might be eliminated very effectively by SWATT SFM application, so data was accepted.

- **Ship Noise**

No ship noise was encountered during this project.

- **Strumming Noise**

The towing noise sometimes slightly affected the front of streamers 4, 5 and 6 throughout the entire survey.

- **Seismic Interference**

None encountered, however the unidentified noise affected data of sequence 6, causing several blocks editing.

- **Rig noise**

None encountered

- **Source problems, autofires**

Occasional misfires or timing synchronization errors resulted in shot edits for some sequences.

The First Break QC and guns timing displays were used to confirm which guns fired at the time, and both the P1/90 and observers log updated to reflect this problem.

- **Parities Problems**

Any shots with parity or Telemetry errors were identified and noted in the acquisition log as a shot edit for that streamer.

24.2 Instrument Summary

There was a slight strumming noise observed streamer-6 during the survey.

On several lines we noticed telemetry error occurred occasionally on streamer 3 and affecting traces 1049 – 1072. Those affected traces were edited out from the coverage and noted down on the observer logs on Edit section.

All noisy traces were noted down on the observer logs and some of them were edited out from the coverage.