

**WesternGeco  
for  
Sierra Geothermal Power Corp  
via  
Schlumberger Water Services**

**Final Acquisition Report for  
Silver Peak 2D Project**

**12<sup>th</sup> October 2009 to 31<sup>st</sup> October 2009**

**Crew 1752**

**Lawson Code CN38**

Schlumberger Confidential

## Contents

Contents.....	2
List of Figures .....	2
List of Tables .....	3
List of Appendices .....	3
1 Overview of Seismic Survey.....	4
1.1 Area Description.....	5
1.2 Weather.....	6
1.3 Crew Personnel.....	6
1.4 Subcontractors and Vendors .....	6
1.5 Vehicles.....	6
1.6 Chronology of the Project .....	7
2 Operations.....	8
2.1 Survey Design and Project Parameters.....	8
2.1.1 Survey Design.....	8
2.1.2 Subsurface Zones of Interest .....	8
2.1.3 Source Parameter Tests.....	8
2.1.4 Project Parameters .....	9
2.2 Permit Summary .....	15
2.3 Survey .....	15
2.3.1 Survey Control.....	16
2.3.2 Real Time Kinematic Surveying .....	16
2.3.3 Processing Results & Quality control.....	17
2.3.4 Wells .....	17
2.4 Archaeological Survey .....	17
2.5 Recording.....	18
2.5.1 Operations description.....	18
2.5.2 Analysis of Operations .....	20
2.5.3 Recording Equipment.....	20
2.5.4 Source - Vibroseis.....	21
2.5.5 Equipment Tests .....	23
2.6 Field Geophysics.....	24
2.6.1 Pre-acquisition Quality Control.....	24
2.6.2 In-field Processing .....	25
3 Production .....	28
3.1 Recording Production.....	28
4 Quality, Health, Safety and Environmental Report .....	29
4.1.1 Environmental Risks.....	29
4.1.2 Potential Energy.....	29
5 Conclusions and recommendations .....	30
Appendix A. Crew 1752 Key Personnel List.....	31
Appendix B. Sweep tests recorded into line D spread .....	32

Schlumberger Confidential

## List of Figures

Figure 1: Preliminary line locations.....	5
Figure 2: Receiver micro layout.....	10
Figure 3: Post-acquisition map .....	10
Figure 4: Source/Receiver numbering scheme & stats Line D .....	11

Figure 5: Line D elevation profile for receivers and sources .....	11
Figure 6: Source/Receiver numbering scheme & stats Line E .....	11
Figure 7: Line E elevation profile for receivers and sources .....	11
Figure 8: Source/Receiver numbering scheme & stats Line F .....	11
Figure 9: Line F elevation profile for receivers and sources .....	11
Figure 10: Source/Receiver numbering scheme & stats Line G .....	11
Figure 11: Line G elevation profile for receivers and sources.....	11
Figure 12: Line Stats for Total Project.....	11
Figure 13: Recording trailer – outside view .....	19
Figure 14: Daily Cable Crew Performance .....	20
Figure 15: Daily broad time distribution.....	20
Figure 16: Example of Real-time Vibrator QC in the Recording Trailer .....	20
Figure 17: Google view of prospect area with final positions .....	25
Figure 18: Field Brute Stack – Line D. ....	26
Figure 19: Field Brute Stack – Line E.....	26
Figure 20: Field Brute Stack – Line F .....	26
Figure 21: Field Brute Stack – Line G .....	26
Figure 22: Daily recording production .....	28

## List of Tables

Table 1: Project parameters .....	9
Table 2: Survey control stations .....	16
Table 3: Survey parameters used in Taylorville 2D project.....	16
Table 4: RTK Survey settings.....	17
Table 5: Cable crew personnel.....	18
Table 6: Line equipment calculation and counts .....	21
Table 7: AHV-IV Vibrator specifications .....	21
Table 8: Vibrator Quality Control .....	22

## List of Appendices

Appendix A. Crew 1752 Personnel List .....	31
Appendix B. Sweep tests recorded into line 501 spread.....	32

## 1 Overview of Seismic Survey

WesternGeco was contracted by Seirra Geothermal Power Corp (SGP) through Schlumberger Water Services (SWS) to conduct a regional 2D survey over their leases in the Silver Peak, Nevada area to determine suitable sites for Geothermal well drilling.

The design of the project was developed in cooperation between SGP, WesternGeco Integrated Services and SWS personnel in Houston and Denver.

WesternGeco crew 1752 performed the survey with Conquest Seismic Services as the principal subcontractor. WesternGeco provided the Q-Land MAS acquisition and processing equipment, plus technical and managerial personnel. Conquest provided the vibrators with Technicians & Operators, line movement vehicles, and necessary personnel to deploy and pickup the line equipment. The operation was supervised by a WG Operations Supervisor, Party Manager/Chief Observer, Project and Chief Geophysicists.

The preparation for the project started in early October 2009, with the necessary BLM permits being acquired by SGP. The survey and acquisition was performed between 14<sup>th</sup> October and 31<sup>st</sup> October 2009. The program of the project comprised the following:

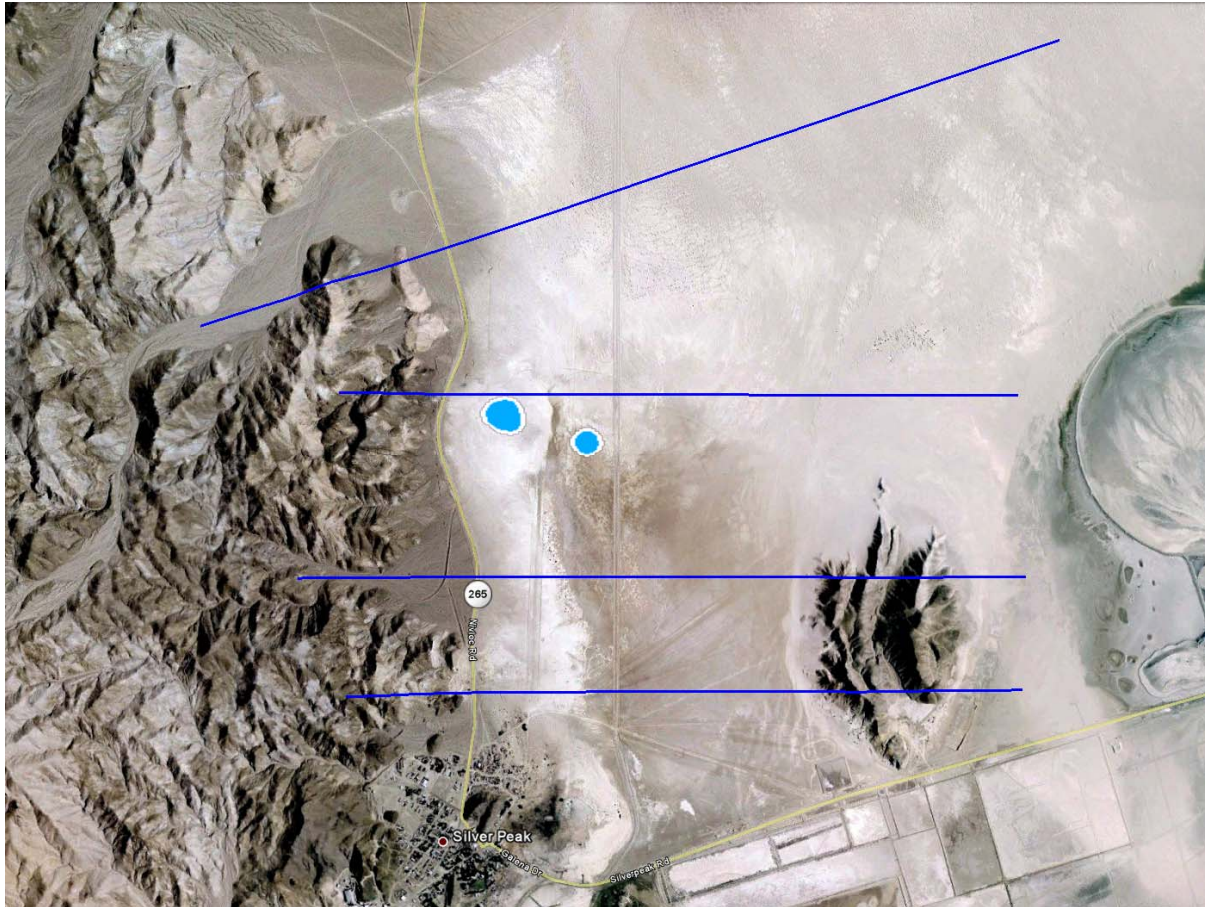
- Client securing the BLM permit and real-time Archaeological Study process to clear necessary 2D lines for vibroseis access.
- Surveying of GAC and vibrator point positions by Erickson Contract Survey as per set parameters.
- Acquisition of surface 2D seismic data on four lines, performed by WesternGeco.

The Silver Peak 2D program was permitted for 12 linear miles, all Vibroseis source. Crew 1752 was temporally based in Tonopah, Nevada at the National 9 Inn, which was about 60 miles northeast of the project area. Due to the short term of this project, no long-term base was established for this project.

Survey mobilization to the project was completed over two days from 13<sup>th</sup> to 14<sup>th</sup> October. Orientation and survey control was established on 15<sup>th</sup> October, with productive survey completed from 16<sup>th</sup> to 23<sup>rd</sup> October, and demobilization back to Sidney, Montana from 24<sup>th</sup> to 25<sup>th</sup> October.

Recording crew mobilization was completed from 22<sup>nd</sup> to 23<sup>rd</sup> October, with receiver layout commencing after full crew start up orientation meeting in Tonopah on 24<sup>th</sup> October. Initial sweep tests were performed on 24<sup>th</sup> October after line D was deployed. Data acquisition of the 2D project started on the 25<sup>th</sup> October after overnight analysis of the sweep tests to determine the best sweep. The acquisition was completed on 27<sup>th</sup> October, with final pickup of equipment completed on 29<sup>th</sup> October, followed by recording crew demobilization from 30<sup>th</sup> to 31<sup>st</sup> October.

Figure 1: Preliminary location of Silver Peak 2D lines



Schlumberger Confidential

## 1.1 Area Description

The prospect area was located in Esmeralda County, Nevada just north of Silver Peak, an unincorporated community and approximately 60 miles to the south-west of Tonopah (pop. 2,627 from 2000 census).

The prospect consisted of steep rocky hills on the west side to flat, flour-like silt terrain over most of the project area. Flour-like silt varied in depths from two inches on the southern line to nearly one foot as we moved north. Alkali areas were also found throughout the area. Prior to commencing the operation, scouting was conducted in August to identify the hazards that would be encountered, enabling the crew to implement prevention and mitigation measures via the HARC system (Hazard Analysis and Risk Control). Close cooperation with SGP Silver Peak Facility Manager, John Deymonaz was instrumental in identifying all local issues that the crew would face. Driving was identified as the highest risk, especially with the long daily commute to the prospect area. Daily sign in/sign out and Journey Management procedures were used to monitor personnel movements.

The area is predominantly used for lithium mining and Silver Peak is currently the major supplier of lithium in the United States. Access to the prospect area is from State Hwy 265, which crossed all four 2D lines.



## **1.2 Weather**

Throughout the project the weather was varied from warm to rain, hail, and some snow. Weather was mostly good during the project acquisition, but a portion of two days were lost due to high winds and snow during the pick-up of the final lines.

## **1.3 Crew Personnel**

Over the course of the project the assigned personnel on WesternGeco Crew 1752 grew to a total of 30 members including subcontracted personnel. The WesternGeco personnel included:

- 1 Operations Supervisor
- 1 Party Manager
- 1 Chief QC Geophysicist
- 1 Project Geophysicist

The personnel list may be found in Appendix A.

## **1.4 Subcontractors and Vendors**

Surveying of GAC and Vibrator Points was conducted by Erickson Contract Survey (ECS) from Sidney, Montana.

Conquest Seismic Services from Denver, Colorado provided personnel for deploying and picking up line equipment and vibrator truck operators.

Xtreme Drilling from Brighton, Colorado provided a QHSE-Adviser to assist WG Managers in training and compliance monitoring.

All subcontractors listed above have had a long term relationship with WesternGeco and are fully integrated and trained in the Schlumberger QHSE Management System.

## **1.5 Vehicles**

Conquest Seismic Services provided 3 AHV-IV Buggy mounted vibrators each rated at 62,000 lbs hold down weight. Twelve vehicles were also provided including F-350 line trucks and F-250/F-350 pickups.

Conquest line trucks were equipped with special boxes fabricated for transportation of 3 LCU's of recording equipment: 30 DGS's and 6 ITO cables. MRU's and fiber optic cable, and batteries were transported by a regular pick-up truck.

WesternGeco managers used 2 F-250 pickups.

## **1.6 Chronology of the Project**

20 August 2009 – Scout of project area completed

13 - 14 October 2009 – Operations Supervisor mobilizes from Sidney, MT to Tonopah, NV

14 - 15 October 2009 – ECS Survey Crew mobilizes from Sidney, MT to Tonopah, NV

16 October 2009 – Survey control network established after project orientation meeting

17 – 23 October 2009 – Productive survey operations

24 – 25 October 2009 – Demobilization of survey crew to Sidney, MT

20 – 23 July 2009 – Recording crew mobilization in phases from California and Denver

24 October 2009 – Project orientation meeting with recording crew, layout of receivers commenced and vibrator sweep testing completed

25 – 26 October 2009 – Layout of receiver lines

25 – 27 October 2009 – Vibroseis recording of four 2D lines

27 – 29 October 2009 – Pick-up of receiver lines

30 – 31 October 2009 – Demobilization of recording crew to Illinois.

Schlumberger Confidential

## 2 Operations

The Silver peak Q-Land MAS 2D project was done to identify locations in the subsurface formations that were suitable for geothermal drilling.

From an operational standpoint, the project was completed without any unexpected issues except for the weather delays during the pick-up phase.

There were power-lines across the lines and a couple of spots of unstable ground, but with Google Earth maps and close communication with the client, we were able to record through them without any issues.

Field data quality looked poor due to the powdery surface conditions affecting the energy from the vibrators, but the field brute stacks generated by the Quality Control Geophysicists each day after the day's production showed that overall data quality was good.

### 2.1 Survey Design and Project Parameters

#### 2.1.1 Survey Design

The survey's evaluation and design was a collaborative effort between WesternGeco's Integrated Solutions Group and SWS in Houston and Denver. The design concentrated on

- achieving very dense single sensor coverage to accurately identify any noise while preserving high frequency signals
- sweep parameter testing
- achieving a high resolution, error free field data set

#### 2.1.2 Subsurface Zones of Interest

The main objectives for the Silver Peak 2D program were to image shallow karsts or cavities to avoid in drilling, while imaging the deeper reflectors for geothermal targets.

#### 2.1.3 Source Parameter Tests

A source parameter test program was conducted in two stages:

- On 24<sup>th</sup> October, - a number of sweeps were recorded using the AHV-IV vibrators. Tests were recorded into the active spread of line D, northernmost line. Sweep parameters used during this testing stage are available in Appendix B. The tests were supervised and evaluated on site by WesternGeco personnel.



- Results were analyzed on site for evaluation and selection of production sweep parameters, which was done by the same group of experts as above. A Maximum Displacement 4-120 Hz 18 second sweep with two vibrator source was chosen for production.

## 2.1.4 Project Parameters

Table 1: Project parameters

Project Name = Silver Peak 2D

Project Size = ~12 linear miles

<b>Receivers:</b>		
	Receiver Line Interval	n/a
	ITO Interval	36 meters
	DGF Interval	12 meters
	PR Density / kilometer	333 single sensors
	DGF Density / kilometer	83 Group Formed channels
<b>Sources:</b>		
	Source Line Interval	n/a
	Source Interval	36 meters
	Shot Density / kilometer	28 VPs
<b>Design Patch:</b>		
	Total Channels / Line	1 x 2,016 = 2,016 single sensors or all line live if less than 2,016 single sensors
	Design – DGF / Line	1 x 504 Digital Group Formed channels
<b>Recording Statistics:</b>		
	Total Live Channels	2,016 point receivers
	Source (Vibrosies)	X2 AHV-IV 62,000lb buggies
	Effort	1 - 18 sec sweep per location
	Sweep Type	4 – 120 Hz Proprietary Maximum Displacement Sweep
	Record Length	6 seconds
	Sample Rate	2 ms
<b>Subsurface Statistics:</b>		
	Bin Size	6 meters
	Bin Density	167 per kilometre
	Nominal Fold	333 post DGF
	Minimum Offset	1.5 meters
	Maximum Offset	3,024 meters

\* PR – Point Receiver, DGF – Digitally Group Formed

All lines were shot with all channels live for each VP.

The theoretical coordinates of the sources and receivers were provided to the Survey department, which was responsible for physically locating and flagging these coordinates on the ground.

Figure 2: Receiver micro layout

GAC Layouts for Nevada 2D Project

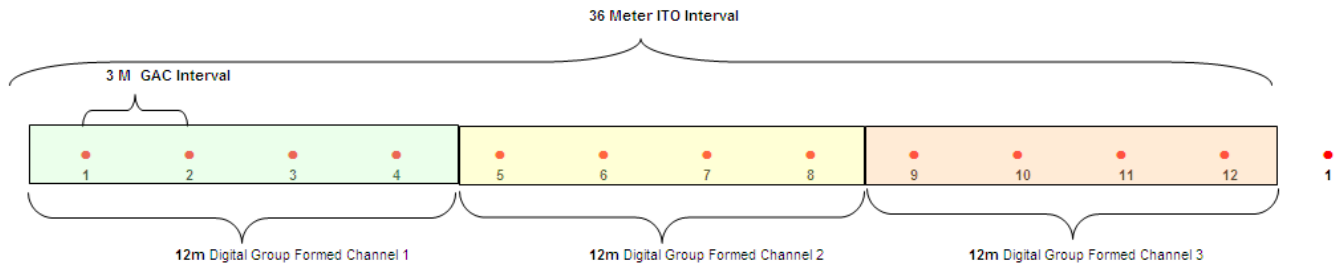
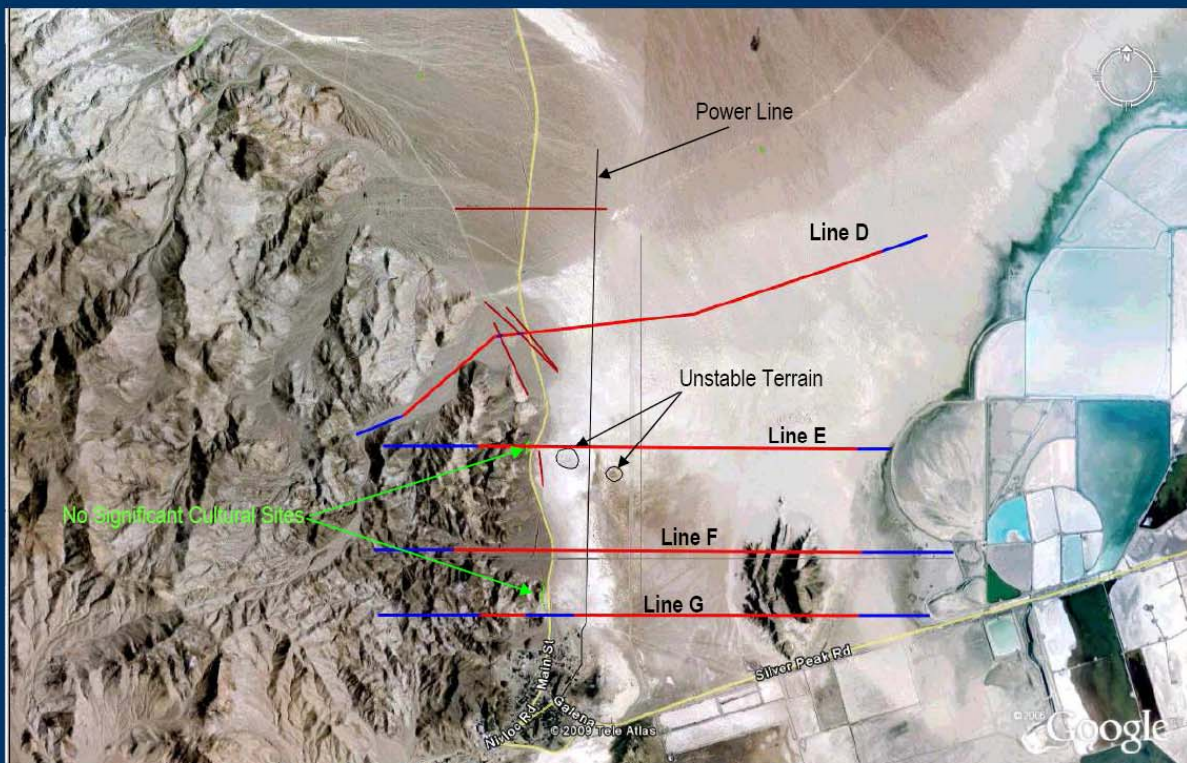


Figure 3: Post-acquisition map

Schlumberger Confidential



Sources and Receivers ———  
 Only Receivers ———  
 Significant Cultural Sites ———

**Schlumberger**



Figure 6: Source/Receiver numbering scheme & stats Line E

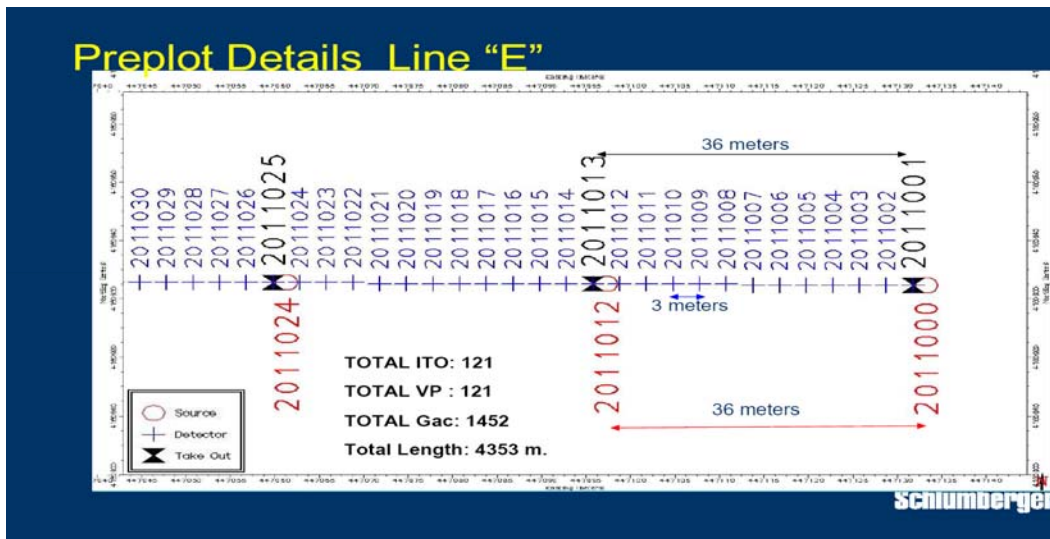
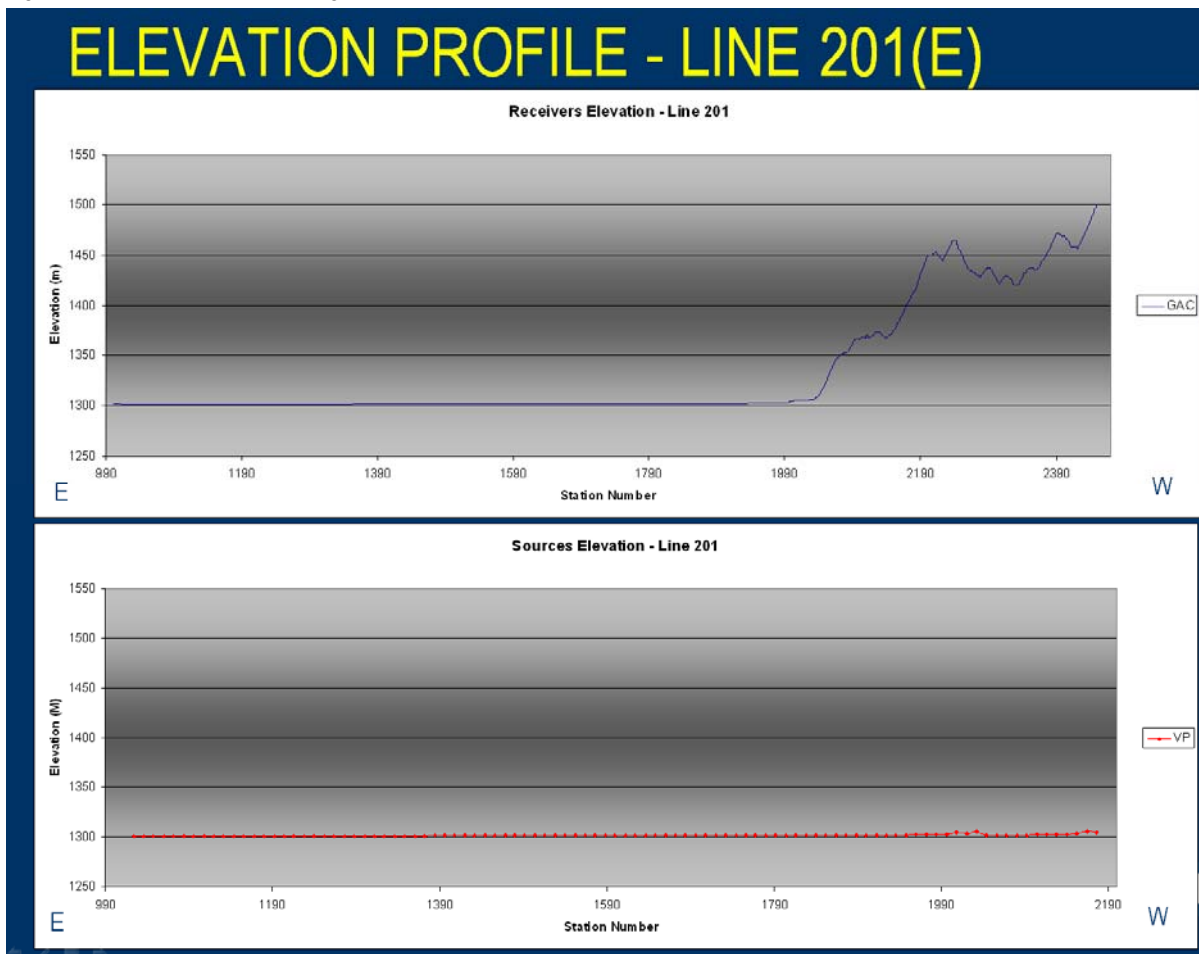


Figure 7: Source/Receiver numbering scheme & stats Line E



Schlumberger Confidential



Figure 8: Source/Receiver numbering scheme & stats Line F

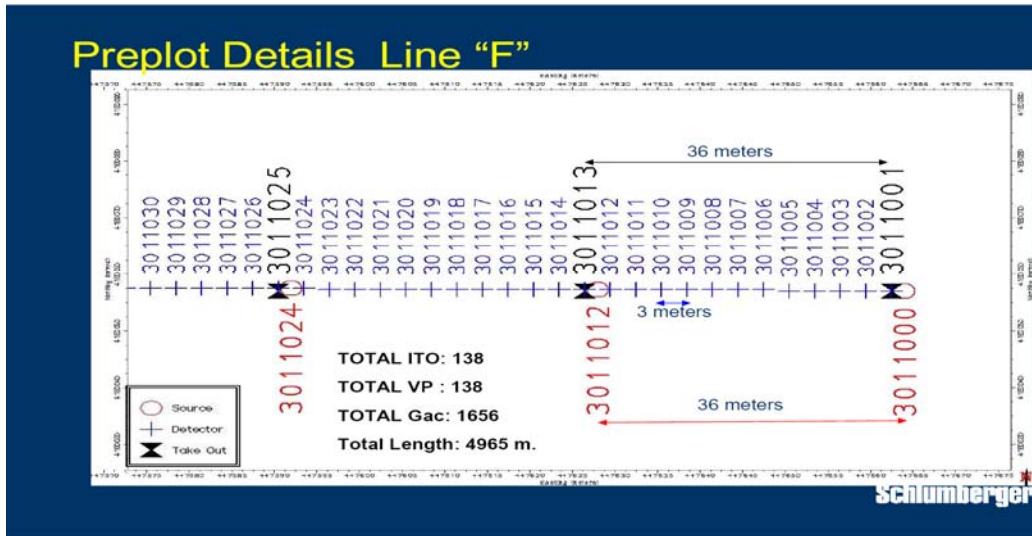
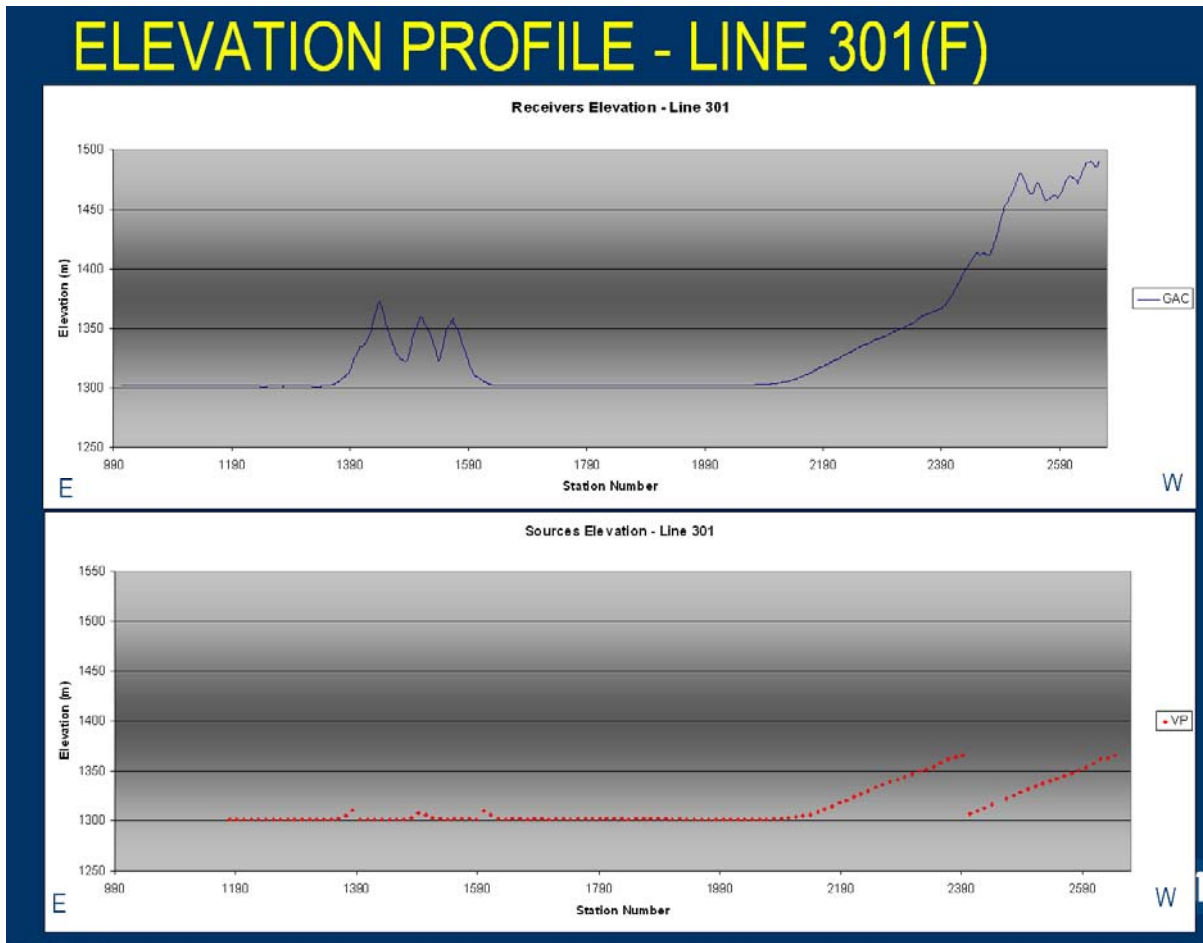


Figure 9: Source/Receiver numbering scheme & stats Line D



Schlumberger Confidential

Figure 10: Source/Receiver numbering scheme & stats Line G

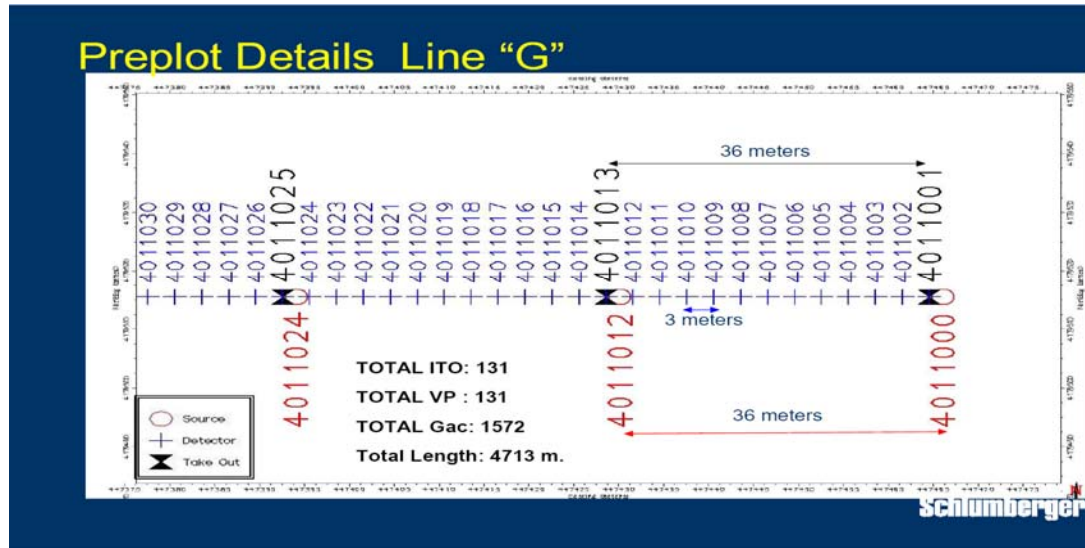


Figure 11: Source/Receiver numbering scheme & stats Line D

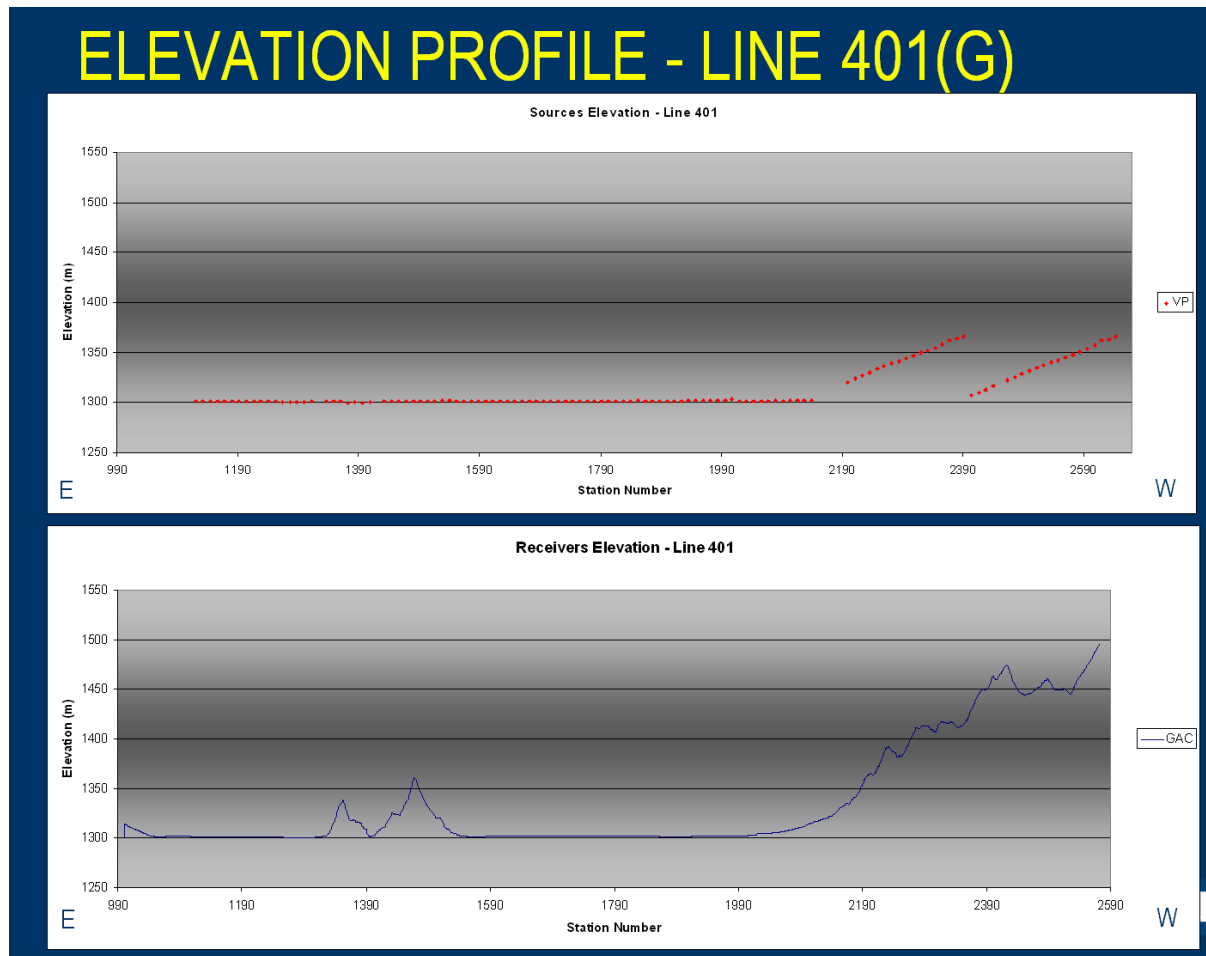
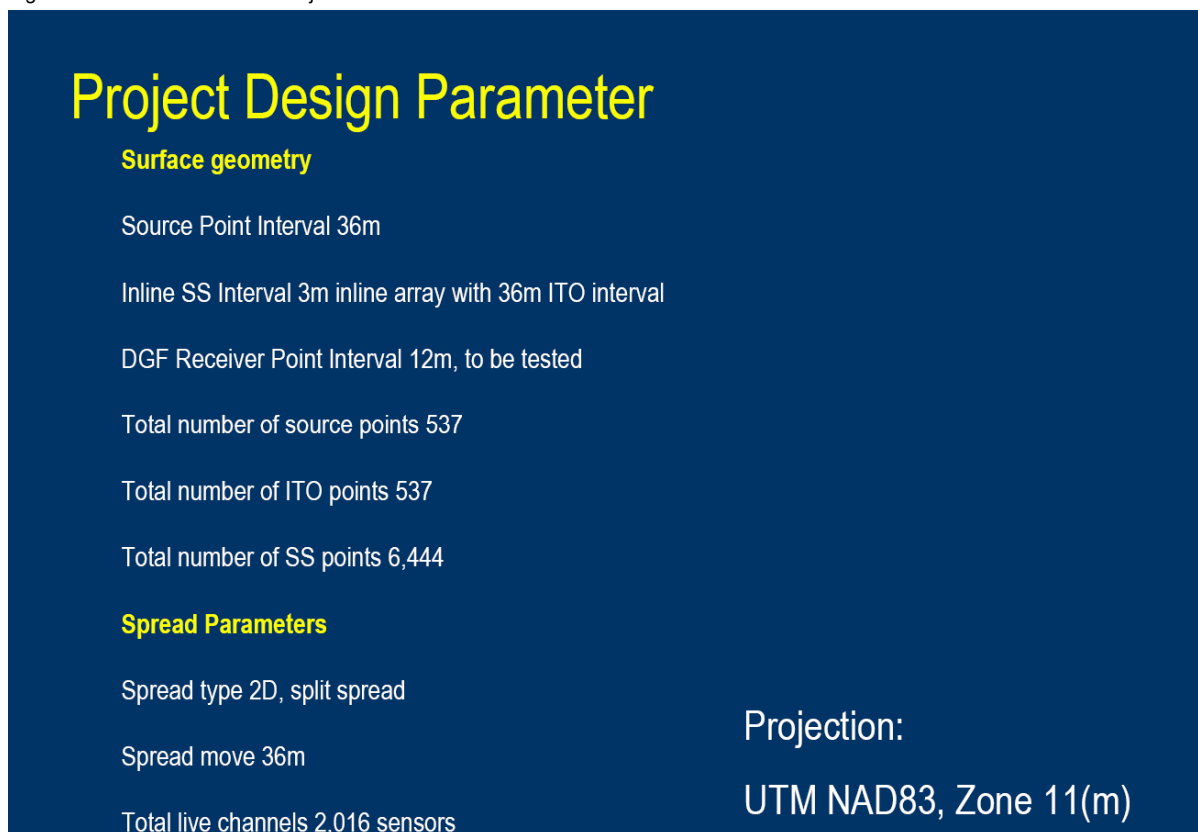




Figure 12: Line Stats for Total Project



Schlumberger Confidential

## 2.2 Permit Summary

Project was all on BLM lands and the permit was secured by the client.

There were no permit issues on the project.

## 2.3 Survey

The main volume of survey operations on the Silver Peak 2D project were carried out between 16<sup>th</sup> October 2009 and 23<sup>rd</sup> October 2009 by ECS survey crews. An orientation meeting between the survey crew and WesternGeco's Operations Supervisor was held on 16th October 2009, and geodetic controls were established the same day. Surveying commenced on 17th October. There were 2 crews active daily, with survey data processed remotely.

An average daily production of 1,288 single sensor points per crew was achieved, with peak daily production of 1,944 positions. A total of 537 VP's and 6,444 Single Sensor positions were surveyed.

The survey team was based out of Sidney, Montana. It consisted of:

- 1 Chief Surveyor / data processor / mapper (remote location)
- 2 rover pack operators
- Lieca System 1200 Dual Frequency RTK System
  - matching the number of crews
  - plus one system for the base station
- 1 crew cab truck

### 2.3.1 Survey Control

Static control survey was established prior to conducting the survey operations with 2-hour sessions at each station. The raw data was processed remotely and returned to the crew. Control information was converted to the local grid coordinates and heights, which were delivered to the crews. The Chief Surveyor converted this information to SEG-P1 format and combined both: control SP1 and pre-plot sp1 to create QLD file to run RTK survey.

Both control and RTK check points were fixed with ~14" long rebars, with marked and labeled caps driven to ground level. No permanent markers were placed during the Silver Peak 2D survey.

Table 2: Survey control stations

Station	Easting NAD83, m	Northing NAD83, m	Ellipsoidal height, m	Ortho height, m
CP-SP-1	444178.051	4179929.170	1285.934	1311.801

Table 3: Survey parameters used in Silver Peak 2D project

Datum Name	NAD83
Ellipsoid Name	GRS80
Semi-major axis	6378137
Reciprocal of flattening	298.257222101
Projection System	UTM 11-N
Projection Type	Transverse Mercator
False Northing	0.000 m
False Easting	500000 m
Origin Latitude	36° 40' 00.000" N
Origin Longitude	117° 00' 00.000" W
Scale Factor	0.9996

### 2.3.2 Real Time Kinematic Surveying

Source stations and ITO positions were marked with fluorescent paint spots on the ground: pink for receivers and orange for sources. For better visibility fluorescent flagging tape of matching color was used on stakes. The survey settings were as listed in Table 3.

Table 4: RTK Survey settings

Elevation Mask	10
Number of satellites tracked	5
PDOP	5
HDOP	3.5
VDOP	5
Epoch Interval	1 sec.
Point Occupation	1 epoch (initially – 3 epochs)
Max. Range from Base Station	10 km (~6.25 mi)
Horizontal staking out accuracy	1 ft
Max. inline single sensor offset	9 ft

The staking accuracy of 1 foot was maintained when laying out points, unless prevented by terrain or obstacles.

### 2.3.3 Processing Results & Quality control

The survey software used for daily quality control of RTK data was GPSeismic™ version 2009.1. The data acquired in the field was checked against the technical GPS (Table 3) and offset criteria. Once the data quality was deemed satisfactory the data was incorporated into the survey database. In the database, additional analysis was run to determine the displacement against the pre-planned coordinates, as well as any missing station through a set of pre-defined queries. If the quality or differences from the pre-plot were out of acceptable range, field re-observations would be done.

The final data was exported in NAD83 values and local height and submitted to the Geo-Support department. Maps were generated to facilitate recording and survey crew operations.

### 2.3.4 Wells

n/a

## 2.4 Archaeological Survey

The permit with the BLM allowed for real-time Archaeological survey along with the production survey of lines. This was arranged, paid directly by the client, and proved to be a very efficient method saving a month or more in preparation time on the project.

Note that this was the first time we have ever been able to operate in this mode with the BLM in any area.

## 2.5 Recording

### 2.5.1 Operations description

The Silver Peak 2D line operations commenced on 24<sup>th</sup> October 2009. The line personnel were supplied by Conquest Seismic Services, and consisted of 2 line crews made up of 14 personnel, 3 trouble-shooters, and 1 Head Linesman.

The cable team was responsible for the layout and pick up of line equipment, and the trouble-shooters were responsible for the fiber optic backbones, replacing the bad equipment from the lines and for changing batteries.

Table 5: Cable crew personnel

	Personnel	Total
Front and Back Crew ( 2 )	14	14
Trouble shooters	3	3
Head Lines men	1	1

Daily cable crew performance is illustrated in Figure 13.

Only minor damage was sustained by line equipment during the project during normal operations.

The amount of equipment brought to the project was sufficient to lay out entire lines and enable efficient rolling from one line to the next.

Line and recording operations were performed during light hours. At around 6:00am the crew would leave from Tonopah after the morning QHSE/Operations meeting (approx. 80 minute drive) via highway 95 for the prospect.

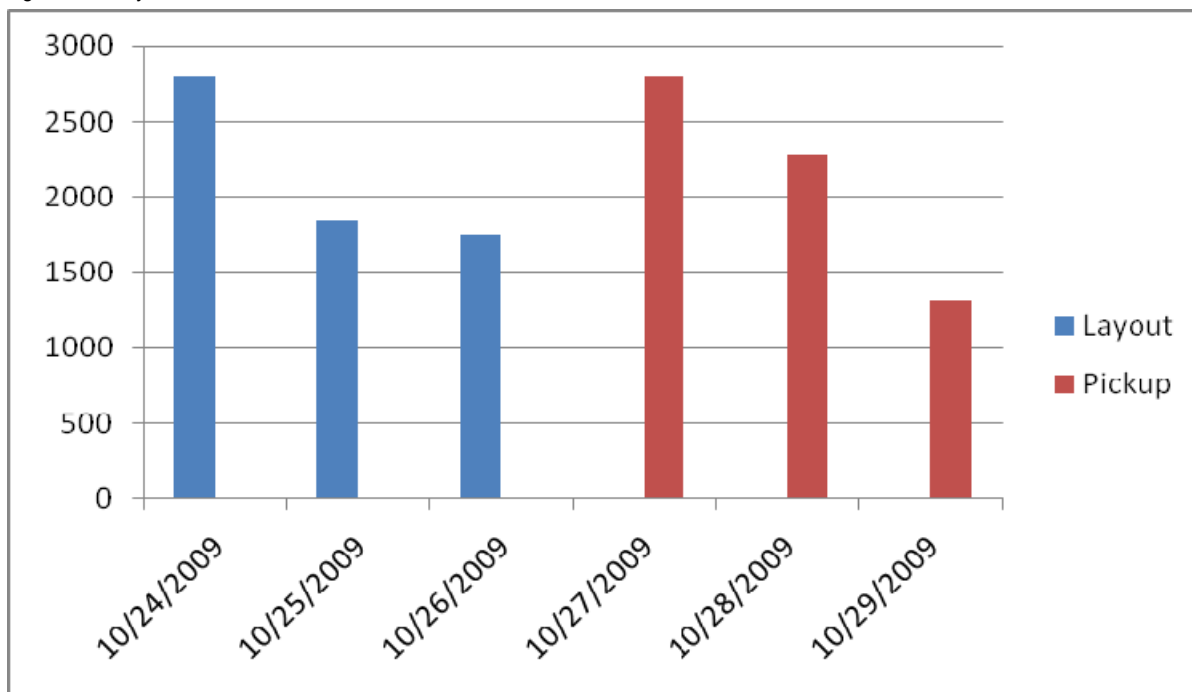
Q-MAS recorder was set up in a custom built utility trailer, powered by a 7.5kVA electrical diesel generator, mounted in the rear of the trailer frame. One AC unit was providing the climate control. This trailer also served as a field office, QC control, Data Processing, and proved adequate for operational use.

Figure 13: Recording trailer on the project



Schlumberger Confidential

Figure 14: Daily Cable Crew Performance



## 2.5.2 Analysis of Operations

The short duration of this project makes it difficult to draw conclusions from timing and production analysis, but all phases were completed within the time frame assumed in the bidding process.

Figure 15: Daily broad time distribution

Graph n/a for this project.

Line equipment downtime was minimal during this project. No power problems occurred and hardly any battery replacement had to be done during the project.

## 2.5.3 Recording Equipment

The recording instrument was the single sensor WesternGeco Q-Land MAS system.

The Digital Geophone String (DGS) is made up of 12 Geophone Accelerometers (GAC) which have the digitizer and acceleration coil element integrated in one case. A pre-amplifier amplifies the coil response to the earth's movement and then the signal is digitized at the sample rate.

### WesternGeco Q-Land Crew 4 System

FAS Serial No: Q-Land MAS-001  
 FCI Serial No: 1240500399/ZA



Manufacturer: WesternGeco

### **Field Acquisition System**

Model: Sun Microsystems V120 s/n TF61150948  
Operating System: Solaris 2.8

### **Vibrator Control Equipment**

- 1 Pelton VibPro (Encoder) Firmware Version 10 C
- 3 Pelton VibPro (Decoder) Firmware Version 10 C

### **Field Equipment**

Table 6: Line equipment calculation and counts

<b>TOTAL ITO PTS: 951</b>	<b>ACTUAL Needed</b>	<b>20% EXTRA</b>	<b>30% EXTRA</b>	<b>EQUIPMENT TO BRING</b>
<b>ITO CABLES</b> (Intelligent take-out)	<b>100</b>	<b>120</b>	<b>130</b>	<b>150</b>
<b>LCU</b> (Line Concentrator Unit)	<b>50</b>	<b>60</b>	<b>65</b>	<b>70</b>
<b>BCU</b> (Battery Converter Unit)	<b>56</b>	<b>60</b>	<b>65</b>	<b>70</b>
<b>DGS, 12 elements ea.</b> (Digital sensor [GAC] string)	<b>500</b>	<b>600</b>	<b>650</b>	<b>700</b>
<b>MRU</b> (Master Router Unit)	<b>5</b>	<b>6</b>	<b>7</b>	<b>7</b>
<b>FO 950m</b> (Fiber-Optic cable)	<b>5</b>	<b>6</b>	<b>7</b>	<b>7</b>
<b>SPA</b> (Solar Panel)	<b>110</b>	<b>132</b>	<b>143</b>	<b>150</b>
<b>EBU</b> (External Battery Unit)	<b>110</b>	<b>132</b>	<b>143</b>	<b>150</b>

Schlumberger Confidential

#### **2.5.4 Source - Vibroseis**

Crew 1752 was equipped with 3 AHV-IV Buggy mounted vibrators. The vibrators were fitted with Pelton VibPro electronics version 10C software. The fundamental ground force was 43,400 lbs. (70% of maximum hold down). Based on the sweep testing program, a two vibrator source array was chosen for the 2D project.

Table 7: AHV-IV Buggy Vibrator specifications

<b>Specification</b>	<b>Value</b>
Type	P-wave
Peak hydraulic force (lbf)	61,800
Maximum hold-down weight (lb)	62,000
Usable actuator stroke (P-P) (in)	3.87
Effective reaction mass weight (lb)	8,120
Baseplate clearance (in)	18

Gross vehicle weight (lb)	66,000
---------------------------	--------

The vibrators underwent a continuous program of quality control checks. On a sweep-by-sweep basis the vibrators were monitored by the QC status returns to the recording truck. Each day, 3 radio similarity tests were acquired for each vibrator. A set of hardwire similarity tests were recorded once the production sweep was determined. The table below gives the specifications that WesternGeco expects the vibrators to comply with. The crew found variability in the vibrator performance depending on the ground conditions. Particularly poorer distortion and signal were observed, when vibrators were in deeper flour like soil, which contrasted with vibrator performance when the vibrators were on solid ground.

Even on the soft soil, specifications were not exceeded, just not as good as the more solid surface.

Table 8: Vibrator Quality Control

Specification	Value
Average sweep phase not to exceed	5 degrees
Peak sweep phase not to exceed	10 degrees
Average sweep distortion not to exceed	25%
Peak sweep distortion not to exceed	35%
Variation of average sweep force from target force	20% in time, <2dB in FK domain

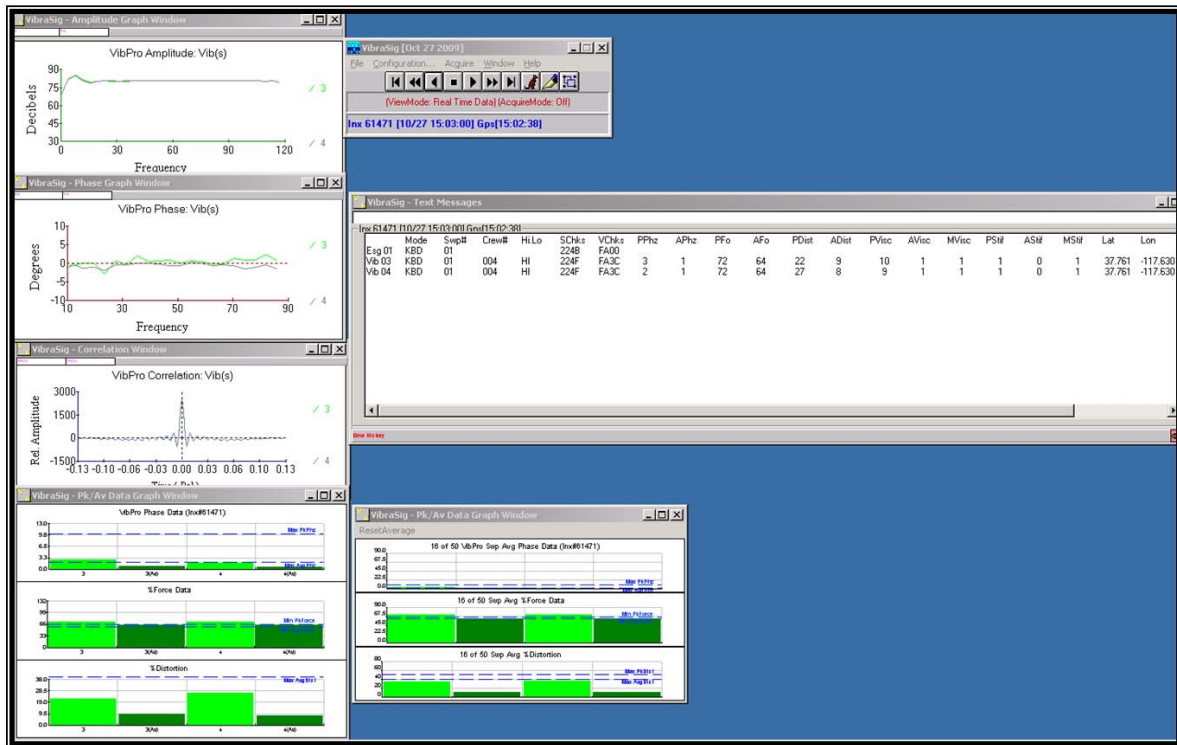
Schlumberger Confidential

Figure 16: Example of Real-time Vibrator QC in the Recording Trailer

## VIB Quality Control in Real Time

### Using Pelton Software

Oct-27<sup>th</sup>, 2009



Schlumberger Confidential

## 2.5.5 Equipment Tests

Prior to mobilizing to the 2D survey area, all line equipment was tested at the Carlsbad, New Mexico crew base as part of the maintenance program, plus underwent daily tests on the project as per procedures.

### Vibrator Testing

The following tests were performed as part of the start-up and acceptance tests for the WesternGeco Q-Land MAS and the AHV-IV Vibrators, for the acquisition of the Silver Peak 2D Survey.

- Start Time adjusted for optimum +/- 20  $\mu$ sec delay between all vibes and RT
- Radio Similarities
- Hardwire Similarities on production sweep

## **Instrument Testing**

A full series of daily instrument tests were run and the results generated by the instrument were cross checked in the Quality Control section by independent third party software Testif-I version 2.0.4. The tests performed included the following:

- Total Harmonic Distortion, recorded at 12 dB pre-amp gain, 2ms sample rate.
- Noise, recorded at 12 dB pre-amp gain; 2ms sample rate. Pulse Test, recorded at 12 dB pre-amp gain, 2ms sample rate.
- Gain Accuracy, recorded at 12 dB pre-amp gain, 2ms sample rate.
- CMRR, recorded at 12 dB pre-amp gain, 2ms sample rate.

## **2.6 Field Geophysics**

The main tasks of the Field Geophysics department during the survey could be split into two distinctive stages:

- Pre-acquisition
  - Quality Control of survey data.
  - Quality control of source points placement.
  - Generation of shooting scripts for the Q recording system.
- Post-acquisition
  - Geosupport
    - Quality Control of vibrator positioning.
    - Processing and Quality Control of instrument tests, hardwires and vibrator similarities.
    - Generation of SPS files.
    - Generation of daily production report.
  - In-field Data Processing
    - Generate and QC correlated data.
    - Test data pre-processing and display.
    - Noise attenuation and Digital Group Forming
    - Generation of infield brute stacked volume

### **2.6.1 Pre-acquisition Quality Control**

Original pre-plot positions of sources, and in exceptional cases – of receivers, were revised, based on updated infrastructure maps, satellite imagery and information coming from the survey and recording teams.

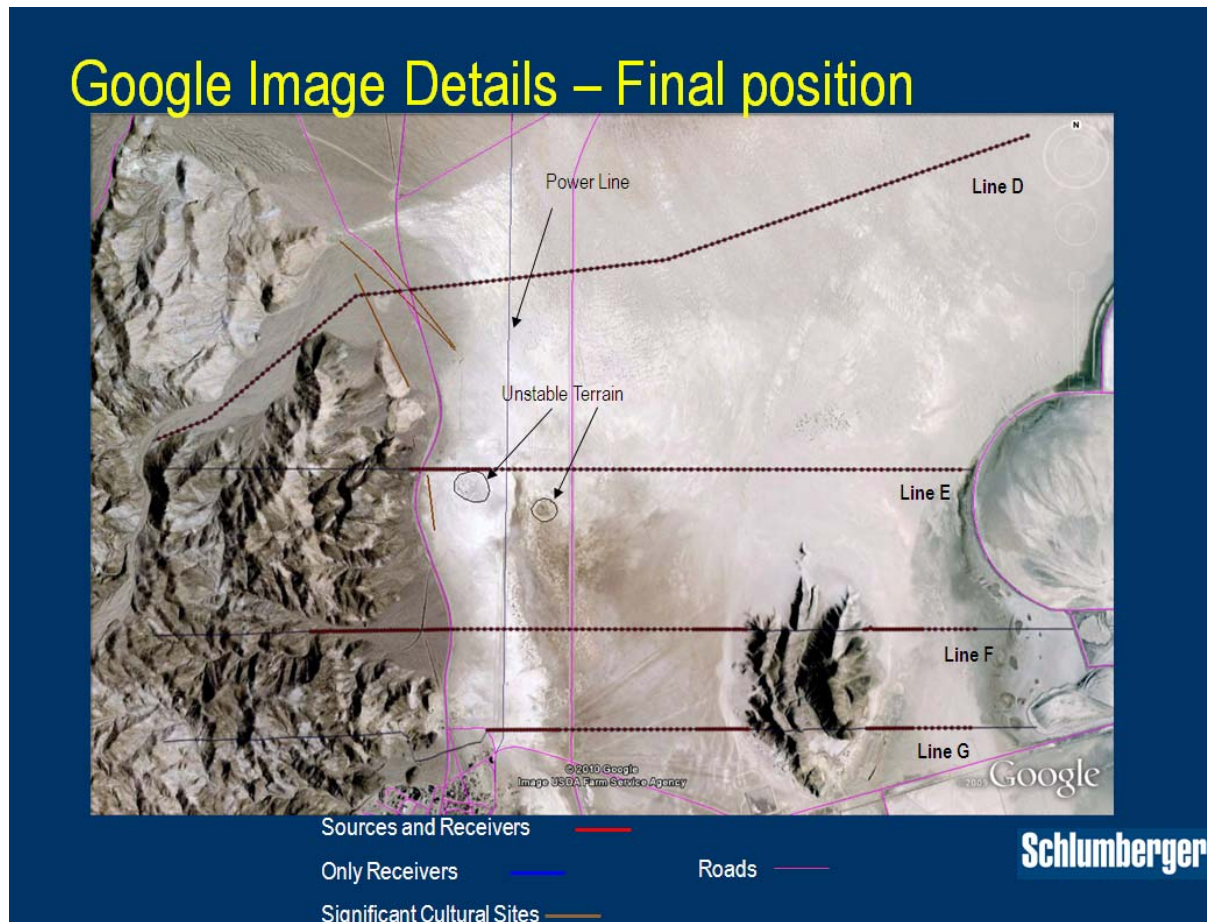
## **Offsets**

Due to being in 2D mode, all points were confined to the BLM approved access, with majority of offsets due to terrain where vibrators could not access.

## **Source skips**

Due to being in 2D mode, all skipped source points were made up at 18m intervals on each side of the relevant skipped area.

Figure 17: Google view of prospect area with final positions



Schlumberger Confidential

### Shooting scripts

Scripts were generated from SPECS for each 2D line independently, and then modified manually to make them more efficient for observer's usage. When there was sufficient time, skipped VPs, identified during post-survey scouting, were removed from scripts. Updated scripts with scouting notes were passed on to observers.

### 2.6.2 In-field Processing

The main tasks of the In-Field Data Processing Group during the survey were:

- Correlate raw data and Quality Control after correlation.
- Produce sweep test record plots and frequency analyses.
- Apply geometry from SPS files and QC.
- Perform noise attenuation and Digital Group Forming.
- Process post-DGF data through field 2D Brute Stacks.

Examples of field brute stacks generated after each day's production are in Figures 16 - 19.



Figure 18: Field Brute Stack – Line D.

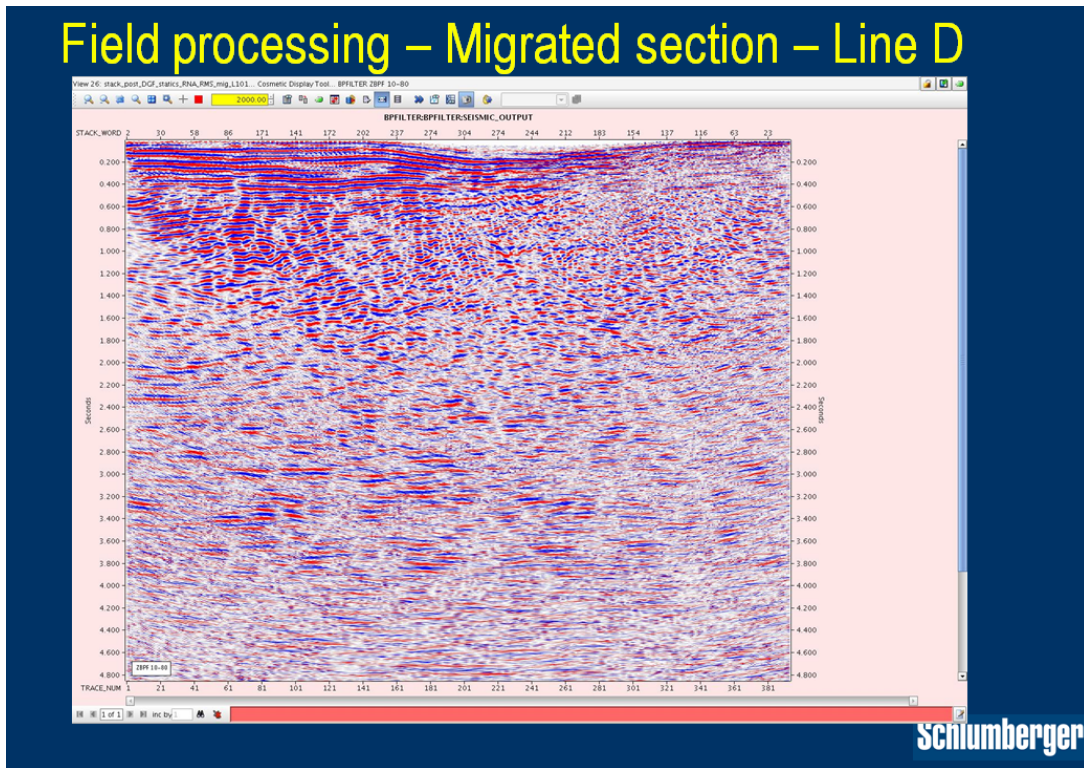
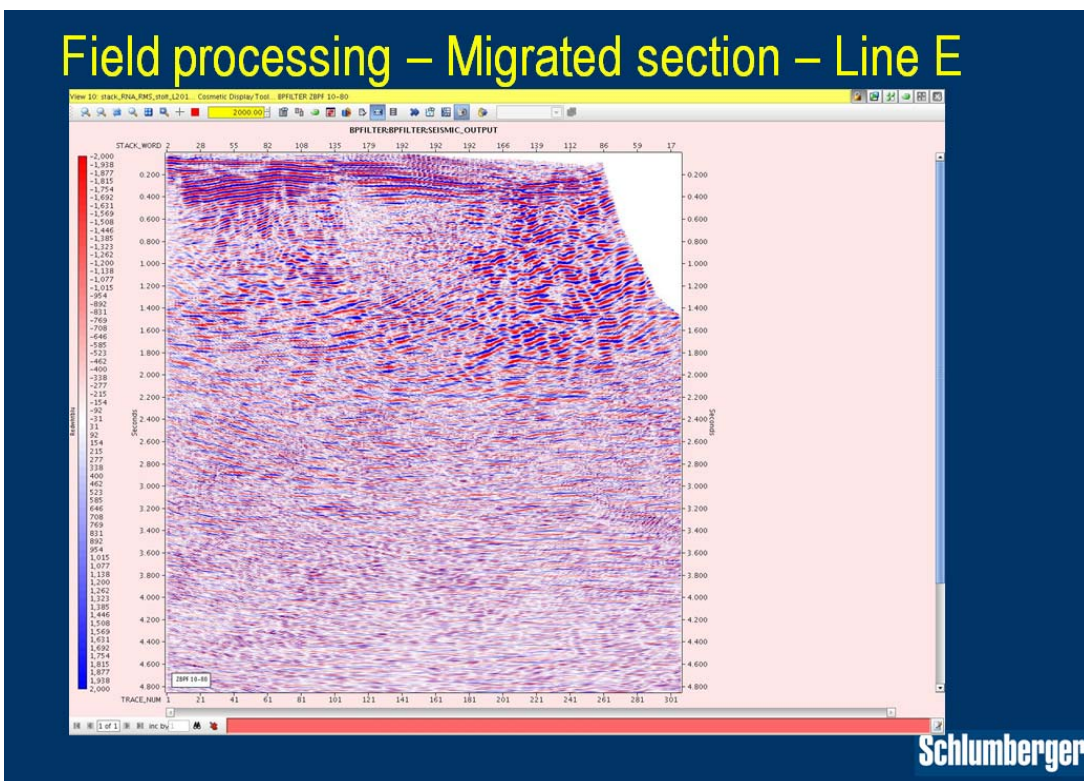


Figure 19: Field Brute Stack – Line E



Schlumberger Confidential



Figure 20: Field Brute Stack – Line F

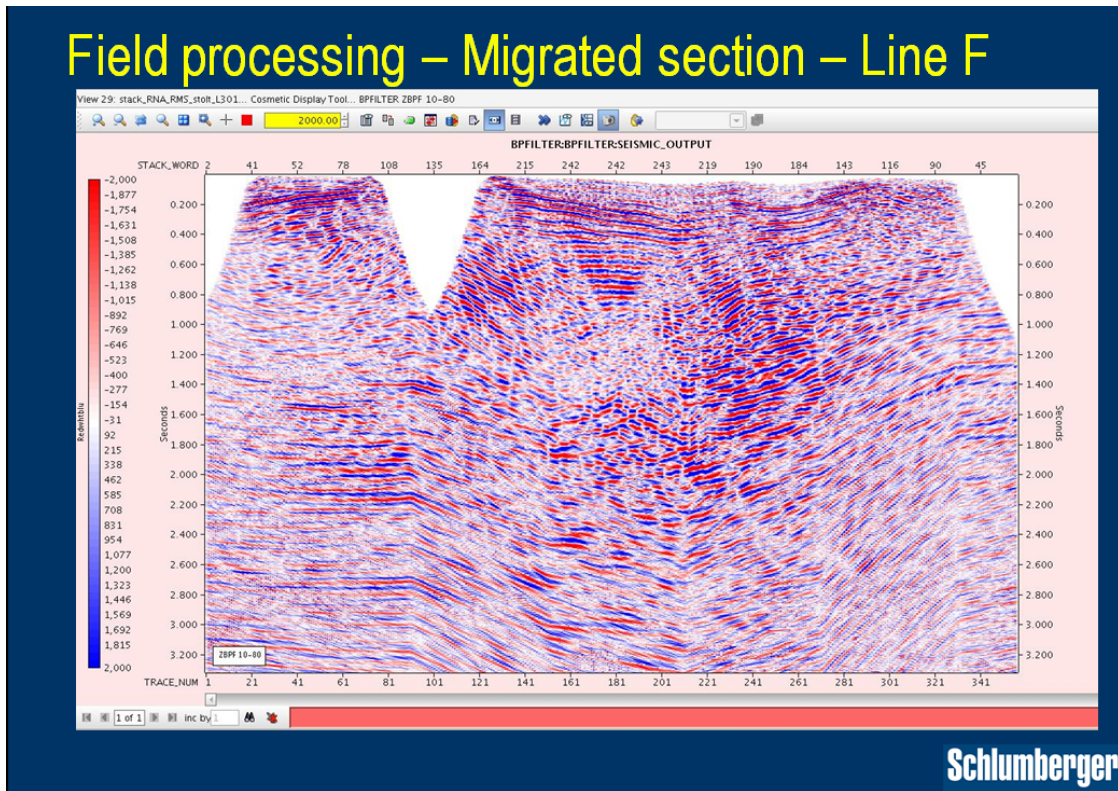
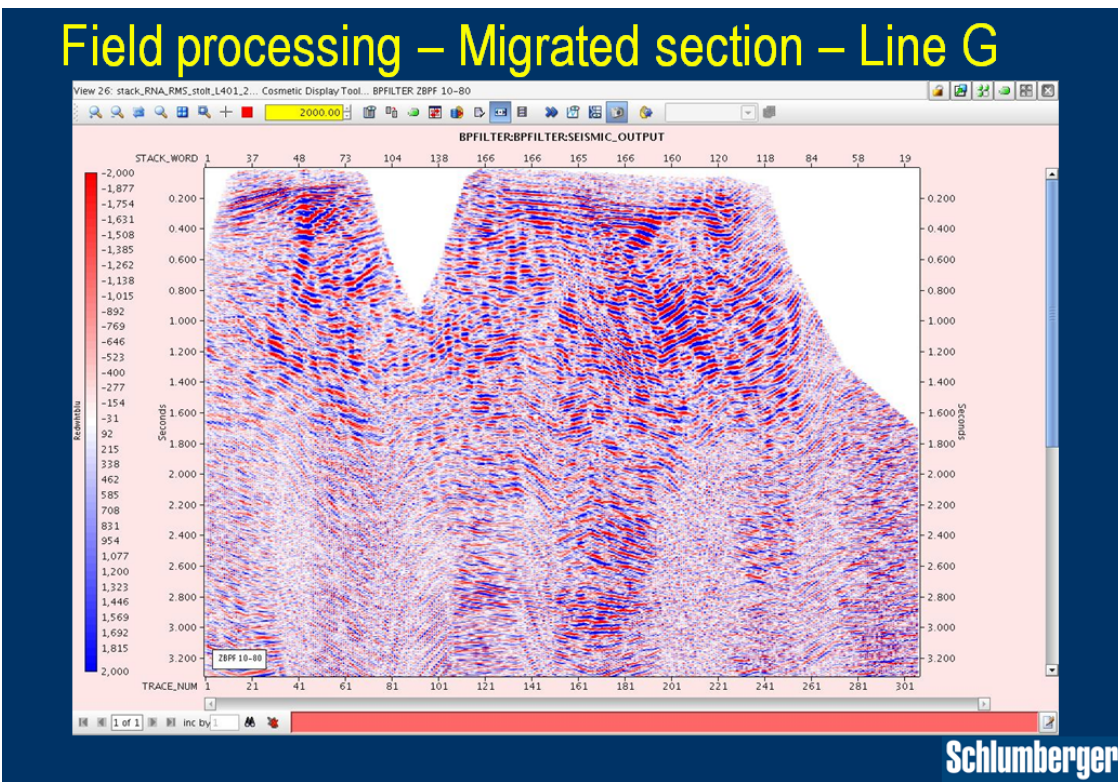


Figure 21: Field Brute Stack – Line G



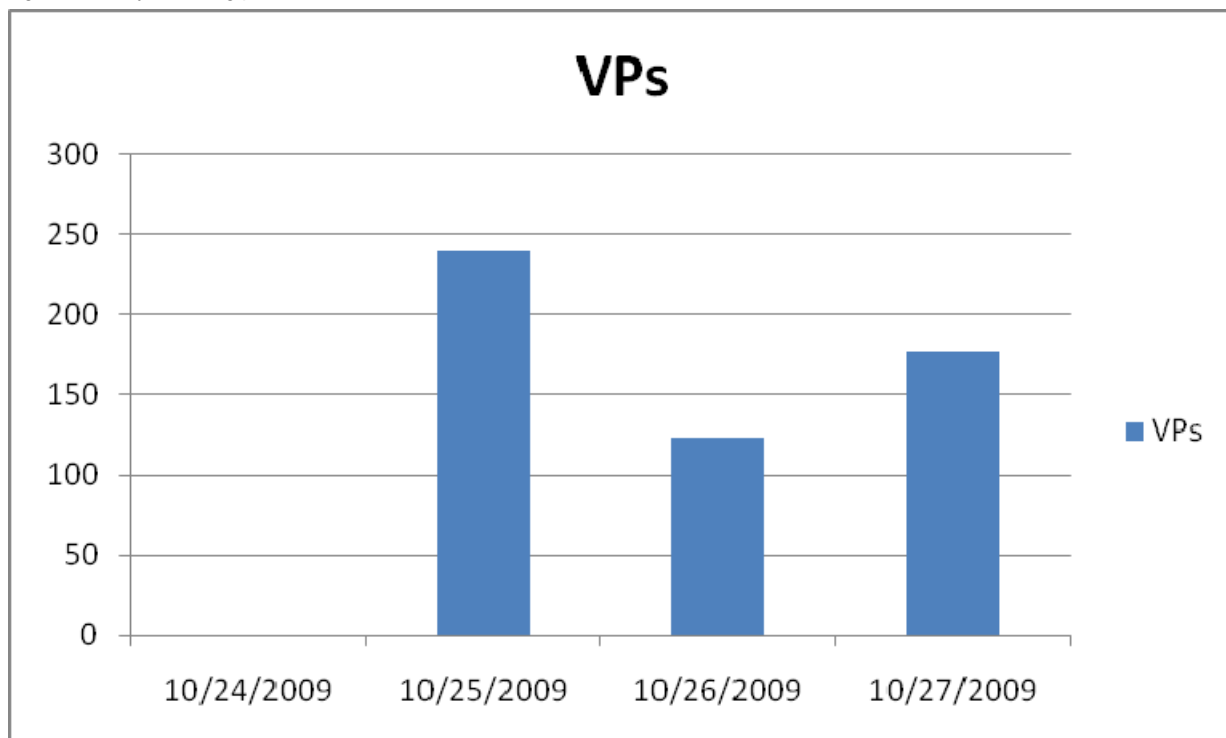
Schlumberger Confidential

### 3 Production

#### 3.1 Recording Production

Daily recording production levels are presented in Figure 23.

Figure 22: Daily recording production



Schlumberger Confidential

## **4 Quality, Health, Safety and Environmental Report**

WesternGeco (WG) Crew 1752 and all subcontractors operated under the Schlumberger Quality, Health, Safety and Environment (QHSE) Management System (MS). All subcontractors have long term relationships working under this system with WesternGeco and have been pre-qualified through our auditing process.

### **4.1.1 Environmental Risks**

#### **Terrain & Weather Related Issues**

High winds could stir up dust severely impacting visibility. Stepping, Handling, Lifting issues were noted at each morning's meeting. Emphasis on drinking plenty of fluids and keeping an eye on your co-workers through the buddy system, especially in areas of walk only on steep slopes while carrying equipment.

#### **Temperature Changes**

Cool in the mornings, hot in the afternoons, so dressing in layers was stressed.

#### **Driving**

Long drive between base and project each day. Travel was completed in convoys with radio communication and sign-in/sign-out sheets to insure everyone returned each day.

All drivers on this project had valid Schlumberger Commentary Drives and Drive SMARRT training.

The project was completed with no Lost Time Injuries or Vehicle Accidents.

### **4.1.2 Potential Energy**

Attention to Handling, Stepping and Lifting activities, which are the most common cause for "low potential" lost time injuries during seismic operations. The risks related to potential energy were one of the main topics of the toolbox meetings. All personnel involved in field operations had valid SIPP (Schlumberger Injury Prevention Program) training.

## 5 Conclusions and recommendations

The crew successfully concluded this project, operating in a new environment and under a reduced crew model, using the Q-Land MAS recording system.

## Appendix A. Crew 1752 Key Personnel List

Land Operations Supervisor	Gerry Devaux
Party Manager/Chief Observer	William Hancock
QHSEA	Stan Law
Conquest Party Manager	Olivier Arbour
Senior Observer	Brad MacKinnon
Chief Geophysicist	Sergio Barrionuevo
Project Geophysicist	George El-Kaseeh
Chief Surveyor	Travis Cundiff
Chief Vibrator Tech	Mike Vance

Schlumberger Confidential

## Appendix B. Sweep tests recorded into line D spread

### START UP SHEET DETAIL

SWEEP PARAMETER TEST - SILVER PEAK 2D - 2009				
TEST	Sweep Type	2 VIBS	1 VIBS	Comments
1	4-120Hz 18sec			5017
	6 sec, listen	X		5018
	60% HD		X	5028
2	4-120Hz 18sec			5010
	6 sec, listen	X		5009
	70% HD		X	5025
3	4-120Hz 18sec			5018
	6 sec, listen	X		5019
	80% HD		X	5020
4	6-100Hz 12sec			5013
	6 sec, listen	X		5015
	60% HD		X	5027
5	6-100Hz 12sec			5012
	6 sec, listen	X		5011
	70% HD		X	5024
6	6-100Hz 12sec			5023
	6 sec, listen	X		5022
	80% HD		X	5021

5014-void

The test position was on Line 101 station #1852

Chosen Parameter:  
4-120 Hz  
18 sec  
6 sec, listen  
70% HD  
2 Vibes

**Schlumberger**

Schlumberger Confidential