Volume 10, Issue 7, July – 2025 International Journal of Innovative Science and Research Technology
ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Recording Parameter Selection and Optimization at the Start of a Seismic Survey

Nwoye Emmanuel C.[1]; Nwoye John T.[2]; Nwokoro Emmanuella C.[3]; Dr. László István Gombar[4]

[1,4]University of Miskoic, Hungary,
[2]Akanu Ibiam federal polytechnic, Unwana, Nigeria,
[3]University of Nigeria, Nsukka, Nigeria.

Publication Date: 2025/07/11

Abstract: This work titled "Recording Parameter selection and optimization at the start of a seismic survey" This topic tries to compare several seismic parameter tests with aim to setup a procedure to validate these records for selection of an optimal recording parameter. Hence, pertains reviewing the basic steps of seismic survey design (time- and space sampling, offset and azimuth distribution, fold of coverage, sources and receiver arrays, source parameter) for both 2D and 3D. It analyzes the basic acquisition parameters such as; sweep frequency, sweep length, sweep number, vibrator number and amplitude spectrum for vibrosis records and charge weight, charge depth, hole number for the explosives records based on signal to noise ratio. Consequent, the dynamic and spectral behaviour of different noises affecting the records, amplitude spectrum and signal to noise ratio is reviewed in this scope of this thesis. Prior to every 2D and 3D seismic project several parameter tests is carried out and at the end the best is choose based on the geological objective. To achieve the above aim several Objectives comes into play which includes: Optimization of Sweep length, Frequency, Dynamite charge depth and Dynamite charge weight. Using VISTA data processing software made by Schlumberger company, the field records of these parameters is compared from different geophysical point of view like; Signal to Noise Ratio, Amplitude Spectral and Signal Energy and at the end an optimize recording procedure can be selected. My goal is to select the optimized parameters, which are suitable for the particular acquisition, by designing a data processing flow for critical noise attenuation and signal to noise ratio enhancement like (De-convolution, two-dimensional filtering, F-K spectral analysis). I used VISTA software for data processing and I have tried to attenuate the critical noises after which compared the various 2D and 3D parameter results on the bases of signal and noise ratio while putting cost allocated to survey into constrain.

How to Cite: Nwoye Emmanuel C.; Nwoye John T.; Nwokoro Emmanuella C.; Dr. László István Gombar (2025) Recording Parameter Selection and Optimization at the Start of a Seismic Survey. *International Journal of Innovative Science and Research Technology*, 10(7), 336-383. https://doi.org/10.38124/ijisrt/25jul175

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

LIST OF CONTENTS

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

CHAPTER ONE
INTRODUCTION

Seismic surveys have become the primary tool of exploration companies in the world, both in onshore and offshore. 3-D and 2Dseismic surveys have lowered finding costs and have made exploration for reserves cannot detectable by other geophysical methods possible. The objective of any exploration venture is to find new volume of hydrocarbon at a low cost and in a short period of time. Searching for hydrocarbons is the goal of seismic method. We can group the principal application of seismic survey into three classes;

- Engineering seismology which is basically targeting the Near Surface geology at the depth of about 100-200 m.

- Exploration Seismology which focuses on hydrocarbon exploration and development of oil and gas. Its depth interval is about500- 8000 m (up 10Km) depending on the geology.

- Earthquake and Crustal studies which is termed earthquake seismology. Its target depth is up to 100km. A non-scientific explanation of how seismic surveys work can be seen below.

A seismic survey is conducted by creating an energy source (shock wave) – a seismic wave – on the surface of the ground along a predetermined and prepared path called seismic line. The seismic wave which travels into the earth is reflected by boundaries between formations, and returns to the surface where it is recorded by receivers called *geophones*. The seismic waves are created either by small explosives charges set off in shallow holes ("*shot holes*") or by large vehicles equipped with heavy plates ("*Vibroseis*" trucks) that vibrate on the ground. By analyzing the time it takes for the seismic waves to reflect off subsurface formations and return to the surface, a geophysicist can map subsurface formations and anomalies and predict where oil or gas may be trapped in sufficient quantities for production.

Prior to every 2D and 3D seismic project several parameter tests are carried out and at the end the best is chosen based on the geological objective.

- *Aim:*

This work tries to compare several seismic parameter tests with aim to setup a procedure to validate these records for selection of an optimal recording parameter. To achieve the above aim several objectives comes into play which includes:

- *Objectives:*

Optimization of Sweep length, Frequency, Dynamite charge depth and Dynamite charge weigth. Using **VISTA** data processing software the field records of these parameters are compared from different geophysical point of view like; **Signal to Noise Ratio**, **Amplitude Spectra** and **Signal Energy.** Depending on the target depth and actual geological objective, the optimized recording procedure can be selected.

- *Scope of Study*

* Review the basic steps of seismic survey design and summarize the aspects of acquisition parameter selection at 2D and 3D seismic surveys: Time- and space sampling, offset and azimuth distribution, fold of coverage, source- and receiver arrays, source parameters.
* Review the characteristics of the coherent and incoherent signals and noises observed on seismic field record in case of vibrosies and dynamite sources.
* Study the spectral and dynamic character of the signals and the different noise types: amplitude spectra, F-K spectra, signal strength, noise power, and S/N ratio.
* Study the effects of different source parameters like sweep frequency, sweep length, sweep number, vibrator number on signal to noise ratio, signal strength and signal spectrum
* Study the effects of different source parameters like charge weight, charge depth, number of shot holes on signal to noise ratio, signal strength and signal spectrum
* Design a data processing flow (Deconvolution, one- or two-dimensional filtering, adaptive noise elimination) for attenuation or elimination of critical noises taking into consideration the target depths and expected resolution, carry out the comparison analyses described under paragraphs 4-5 After application of the optimal noise reduction data processing procedure.
* At last on the base of data analysis selection of optimal source parameterfor particular survey under constrain of the allocated survey cost.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

CHAPTER TWO
SEISMIC SURVEY METHODS

➢ *There are three Phases of Seismic Exploration:*

- Data acquisition
- Processing
- Interpretation

However, based on the scope of work, this paper will focus basically on the first two: data acquisitions and processing**.** Preparing an overall time line for data acquisition will avoid surprises and keep expectations somewhat close to reality.

➢ *Acquisition*

In on-shore data acquisition the energy source for a seismic survey is Vibroseis, Air gun, explosive charges, or weight-drop. Vibroseis truck has a large metal plate that is lowered onto the ground so that the entire weight of the truck is on the plate. The plate is then caused to vibrate at a specified power and frequency, creating seismic waves that travel into the ground. One single vibrator truck (the largest one which is available on the seismic market) can generate more than 80 000 pounds of ground force. In some cases up to five trucks are clustered together to create the energy at each source point, creating a combined ground force of several hundred –thousand of pounds.

Fig 1 Vibrator Truck of Type Failing Y-2400 is Ready to Start Vibration

If the energy source is an explosive charge, the charge is usually loaded into a hole between 3-100m (10-300) feet deep, drilled for that purpose. Holes depths rarely exceed 24meters. The charge is a specified number of pounds of explosive – generally from 1 to 20 pounds (0.5-10kg), depending on the depth and the result of the parameter test.

The area covered by the 3D grid must be larger than the subsurface area to be imaged, in order to acquire sufficient data for the area of interest. Generally, in order to acquire "*full-fold* data for an area, source and receiver points must be laid half spread beyond the boundary of the area of interest. The additional data acquired in this "halo" on the outer edge of a 3D survey is sometimes called "*tails*"or taper zones. The quality of the subsurface data at the edge of the survey will lower due to low fold.


Fig 2 Geophones in Land- and Marsh Case with the Electromagnetic Element Inside

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

3D surveys must be conducted over a large area in order to provide sufficient data for accurate interpretation of the subsurface geology. 3D surveys commonly cover more than 50 square miles. 3D surveys conducted at different times and covering different but adjacent areas can later be combined into a single data set for processing and analysis, provided there is sufficient overlap of the areas covered by the two surveys.

➢ Types of Recording Systems

In seismic acquisition we have various recording systems which can be categorized into three groups and have peculiar advantages and disadvantages to seismic recording.

- *Traditional Non-Distributed Wire Line Systems (Cable System):* Up to thousands of channels systems

- *Advantages:*

✓ Real time signal transfer from the geophones to the central recorder
✓ Spread controlled from the recorder in real-time.
✓ Digital data transfer in the whole or in the part of the transfer cable
✓ Amplifiers, filters, A/D converters only in the central unit

- *Disadvantages:*

✓ Cross-feed and noise pickup problems
✓ Heavy stacking cables – difficult field deployment (30-40 kg/100m)
✓ Multi-pin connectors at each 100 m
✓ Cable problems (cut, drag, short-circuit etc.)

- *Telemetry, distributed systems:* up to hundreds of thousands channels systems

- *Advantages:*

✓ High speed serial signal transfer from the digitizing units to the central recorder (100 000 samples / 2 ms)
✓ 2-4 parallel wire data pairs in one cable (wire or optical)
✓ Analog signal only from geophone to the digitizer unit or no analog data at all (digital sensors)
✓ Much less cross feed and noise pickup problems
✓ Light weight thin cables and light digitizers (3-5 kg/100m)
✓ Simple 4-8 pin connectors at each 200 m
✓ Designed for 3D line network – parallel receiver lines with backbone data transfer connection to the recorder
✓ Easy cable repair

- *Disadvantages:*

✓ Several tons of cables to move and transport in the field
✓ Requires many people and car support
✓ Vulnerable cable connection, long repair time in case of cable problems

- *Wireless, stand-alone systems:* unlimited number of channel

✓ No real-time data transfer to central unit at all
✓ Geophones and battery are connected to a stand-alone data collector
✓ Analog signal only from geophone to the data collector
✓ Clock accuracy adjustment to satellite GPS time
✓ GPS receiver in each data collector

- *Advantages:*

✓ No cables, much less logistics
✓ Only source management in the central unit
✓ No cross-feed
✓ Light weight

- *Disdvantages:*

✓ No real-time Quality Control (QC) in the central unit

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

- ✓ Shooting blind for days/weeks, no spread noise control
- ✓ No feedback on battery status and no theft control

Table 1 Showing Different Types of Recording System, their Channel Capacity and Their Manufacturer (C - Cable Connected, CF - Cable Free)

Manufacturer	**System**	**Cable/Cable FreeMax**	**Channelnumber.**
Sercel	428/508	C	100 000
Sercel	Unite	CF	unlimited
ION	Aries II.	C	100 000
ION	Scorpion	C	100 000
ION	Hawk	CF	unlimited
Fairfield	Zland	CF	unlimited
Geospace	GSX	CF	unlimited
Wireless	Eagle	CF	unlimited
Schlumberger/Western	Unic	C	100 000

- *Data Processing*

The recorded data from a seismic survey is originally in its "*raw*" or "*unprocessed*" form. Before it is used, it must go through a series of computerized processes. These processes includes – *filtering, stacking, migrating* and other computer analysis, make the data usable and require powerful computers and sophisticated computer programs. As computers have become more powerful and processing techniques more sophisticated, it has become common to *re-process* seismic data acquired in earlier years, creating new opportunities for exploration that originally could not be derived from the 3D data. Processing of data can be very expensive and time-consuming, depending on the size of the area surveyed and the amount of data acquired. Processing of data from one 3D survey may take several months.

- *Data Interpretation*

Finally, the resulting processed data must be interpreted by the geophysicist or geologist. All seismic data is subject to interpretation, and no two experts will interpret data identically. Geology is still a subjective science. Although dry holes have been greatly reduced by 3D seismic technology, they have not been eliminated. The proper interpretation of 3D data is a critical step in the process.

➢ *Planning of a 3D Seismic Survey*

Acquisition of 2D and 3D both follow a systematic sequence of event, with acquisition prices falling at a fast rate and higher channel capacities being available, 3D acquisition becomes the favored choice over 2D acquisition. However, the below is the general way in data acquisition.

- Planning of the 2D or 3D survey
- Scouting
- Check On Local Operating Conditions
- Design of the survey (2D OR 3D)
- Request for Regulatory Approval
- Send out Bid Request
- Sign Legal Contract
- Permit Land Owners for Access
- Land Surveying
- Parameter Testing
- Shot Hole Drilling If necessary
- Recording

➢ *D Seismic Design Using OMNI*

Using OMNI seismic processing software I designed 3D seismic survey with aim of illustrating some basic important seismic survey parameters: Offset and Azimuth distribution, fold coverage, source and receivers arrays, source parameter and time and space sampling.

➢ *Definitions OF 3D Term:*

for the better understanding of 3D some important terminology are needed to be defined.

➢ *Orthogonal Geometry*

Though there are various methods of 3D geometry which can be employed in data acquisition. But often source and receiver lines are laid out orthogonal to each other in onshore 3D surveys. Such geometry is easy for survey and recording crews to follow

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

and keeping track of station numbering is straightforward. For instance, receiver lines could run east-west and source lines north-south, as you will see in Figure 3 below, or vice versa. In this geometry, all source stations between adjacent receiver lines are recorded, the receiver patch is rolled and the process is repeated.

➢ *Receiver Line:*

A line along which receivers are laid out at regular intervals. The in-line separation of receiver stations (receiver interval, RI) is equal to twice the in-line dimension of the CMP bin. Using a cable connected recording equipment, field recorder cables are laid along these lines and geophones are attached as necessary. There are wireless systems also available. The distance between successive receiver lines is commonly referred to as the receiver line interval (or RLI). The method of laying out source and receiver lines can vary, but the geometry must obey simple guidelines.

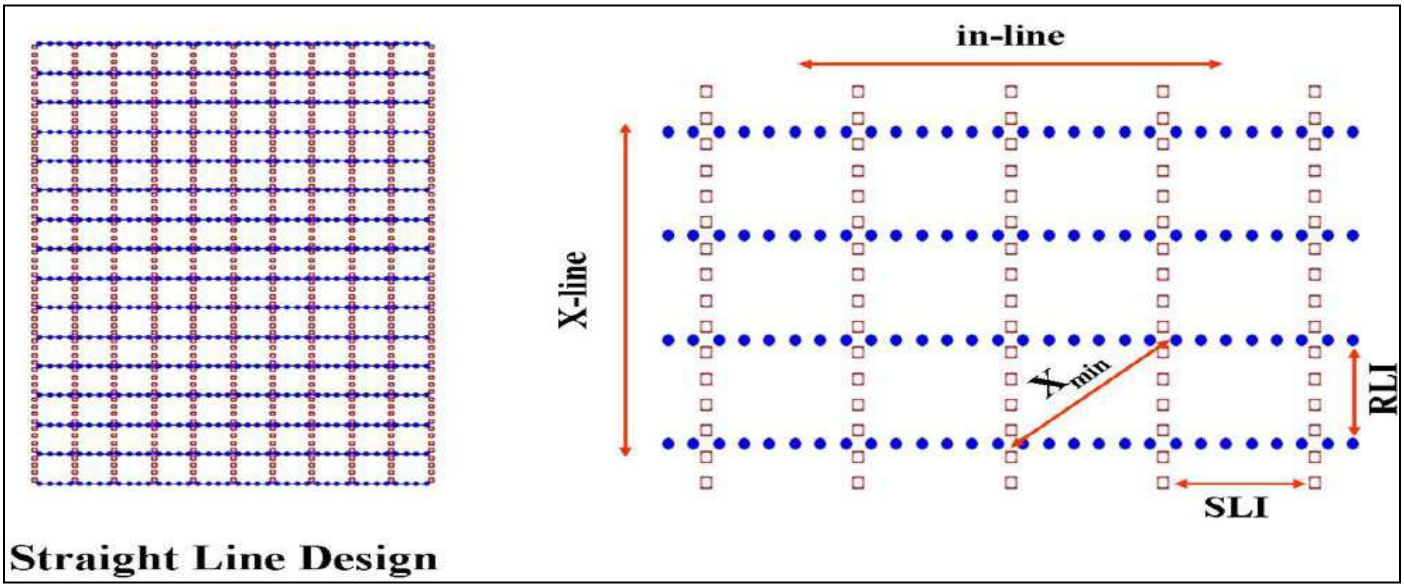


Fig 3 Orthogonal 3D Field Geometry

- *In-line Direction:*

  The direction that is parallel to receiver lines(blue dots).

- *Source Line (X-Line Direction):*

  A line along which source points (e.g., dynamite or vibrator points) are taken at regular intervals. The cross-line separation of source points (source interval, SI) is equal to twice the common midpoint (CMP) bin dimension in the cross-line direction. This geometry ensures that the midpoints associated with each source point will fall exactly one midpoint away from those associated with the previous source point on the line. The distance between successive source lines is usually called the source line interval (or SLI). SLI and SI determine the source point density (or SD, source points per square kilometer).

- *Cross-line Direction:*

  Cross-line Direction is the direction that is orthogonal to receiver lines.

- *Source Point Density (Sometimes Called Shot Density) SD:*

  The number of source points/km2 or source points/mi2. Together with the number of channels, NC, and the size of the CMP bin, SD determines the fold.

- *Xmax:*

  The maximum recorded offset, which depends on shooting geometry. *X*max is usually the half-diagonal distance of the patch. Patches with external source points have a different geometry. A large *X*max is necessary to image deeper events.

- *Xmin:*

  The largest minimum offset in a survey (sometimes referred to as LMOS, largest minimum offset) as shown in the figure above "Box." See Figure 3. A small *X*min is necessary to record shallow events.

- *Patch:*

  A patch refers to all live receiver stations that record data from a given source point in the 3D survey. The patch forms a rectangle of several parallel receiver lines if the geometry is orthogonal. The patch moves around the survey and occupies different template positions as the survey moves to different source stations.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

➢ *A Theoretical 3D was Designed to Demonstrate the Planning Geometry Parameters:*

- *Summary of Design Parameters for the 3D*

✓ *Receivers Areal Summary:*

Total # of Included Receivers = 10250
Total Area of Included Receivers = 95.616 sq km
Receivers density = 107.200 per sq km
Number of Active lines = 20
Number of active channels per line= 150

✓ *Receivers Line Summary:*

Average Line Interval = 240.0 meters
Total # of Included Lines = 42
Min # of Included Stations per Line = 250
Max # of Included Stations per Line = 250
Total Included Line Length = 408.36 km
Average Station Interval = 40.000 meters
Average Bearing of Lines = 90.000 degrees

✓ *Shots Areal Summary:*

Total # of Included Shots = 8750
Total Area of Included Shots = 94.819 sq km
Total # of Included Shots = 8750
Total Area of Included Shots = 94.819 sq km
Shots density = 92.281 per sq km

✓ *Shots Line Summary:*

Average Line Interval = 280.0 meters
Total # of Included Lines = 35
Min # of Included Stations per Line = 250
Max # of Included Stations per Line = 250
Total Included Line Length = 348.60 km
Average Station Interval = 40.000 meters
Average Bearing of Lines = 360.000 degrees

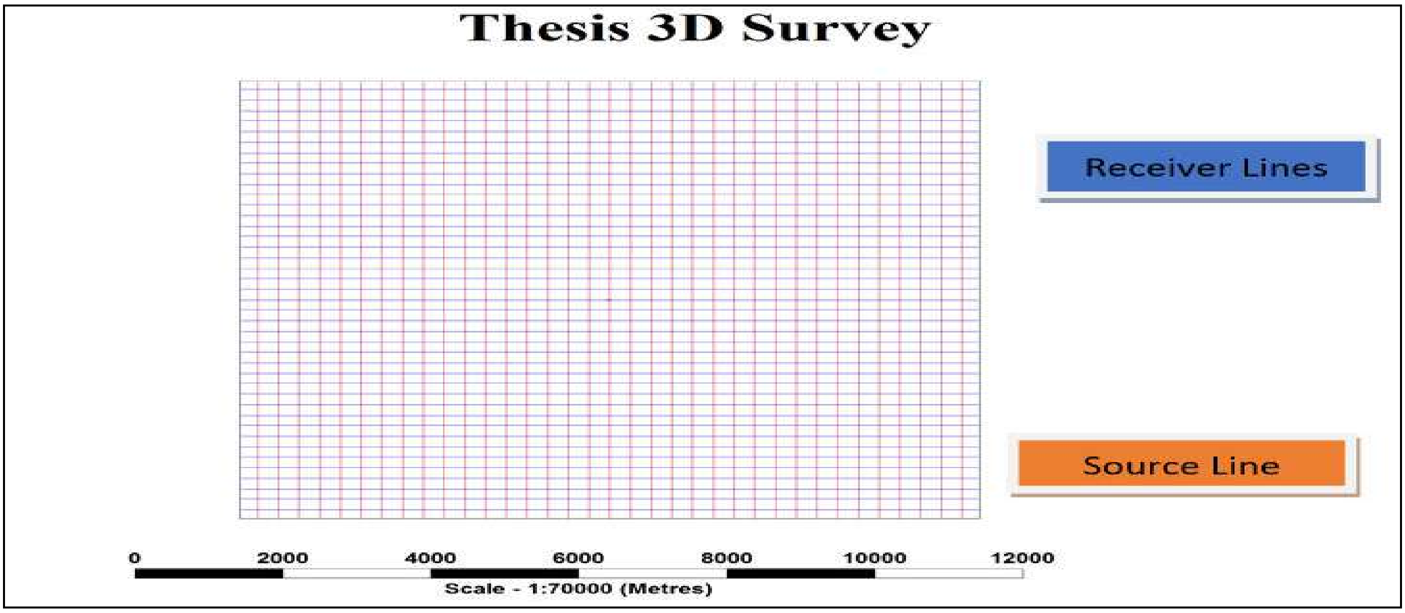


Fig 4 The Designed Orthogonal 3D Survey the Blue Line is the Receiver and Red Line the Source

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

➢ *Offsets and Azimuth Distribution*

Each Common Mid-Point (CMP) bin usually contains midpoints from many source-receiver pairs; each contributing trace in a bin has an offset (distance from source to receiver) and an azimuth (deviation from 0° north or compass angle) from source to receiver. For a successful 3D survey it is of important to consider both offset and azimuth distributions. Both are affected by the recording geometry.

Increasing the fold can improve the offset and azimuth distribution as well. It is necessary to get an even offset from near to far offsets to enhance velocity calculations for normal move out corrections and to achieve the best stacking response. An offsets badly mix can cause aliasing of dipping signal, source noise, multiples, creation of acquisition footprint.

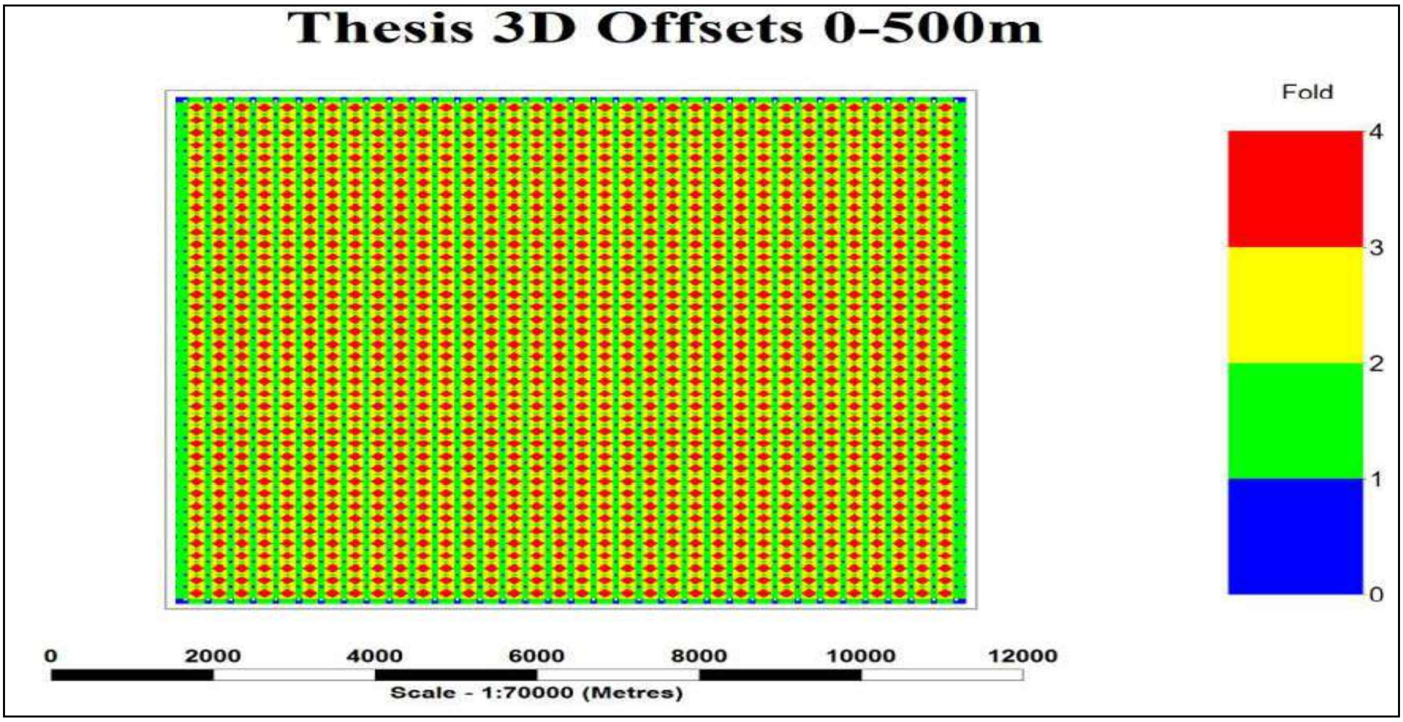


Fig 5 Near Offset Distribution of the Designed Field Geometry

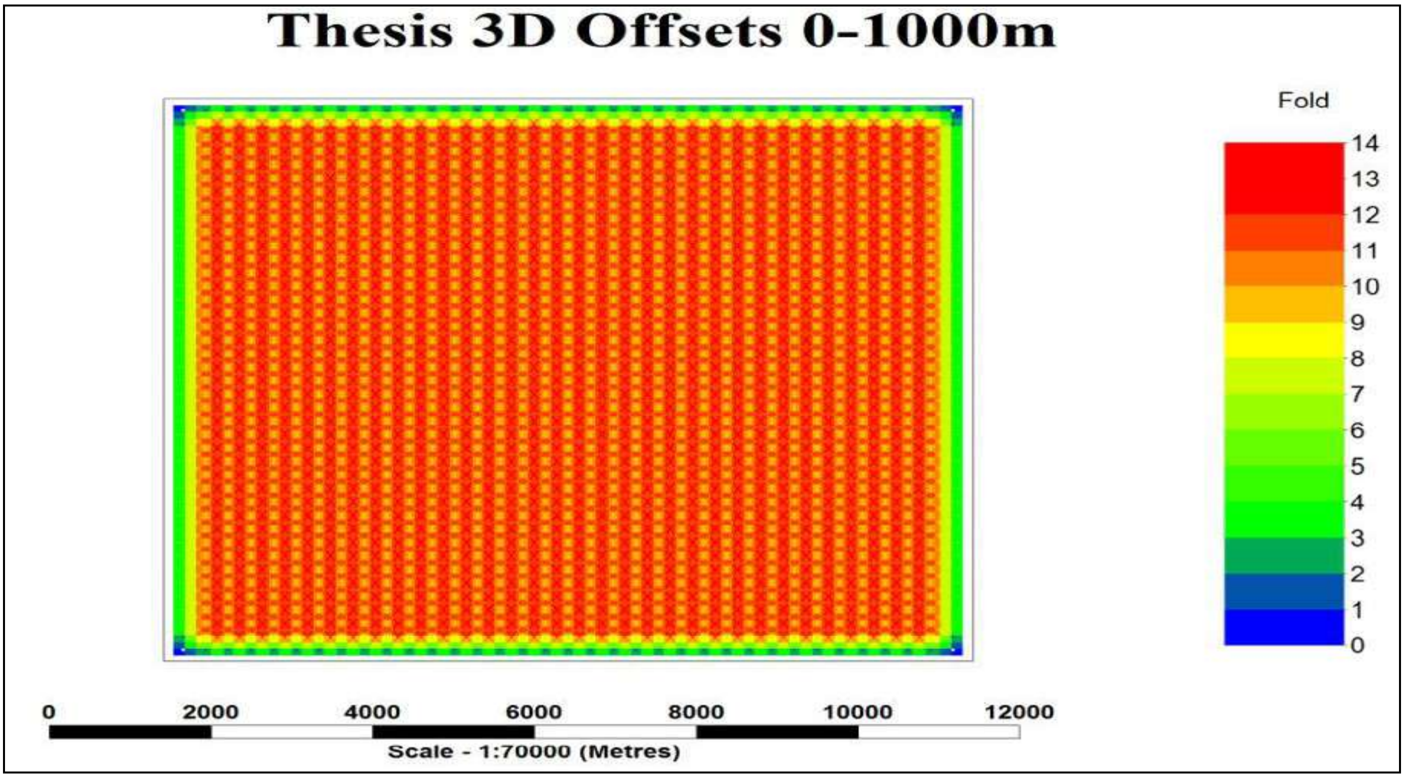


Fig 6 Fold Distribution in a Limited Offset Domain 0-1000 m

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

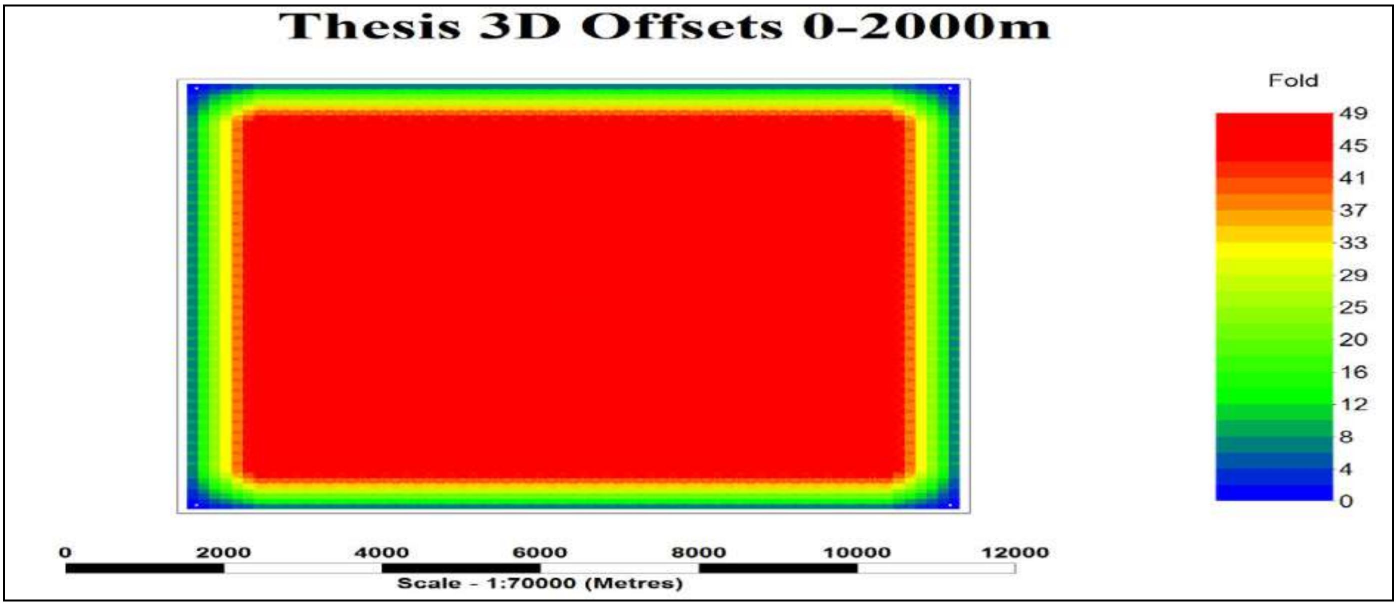


Fig 7 Fold Distribution in Limited Offset Domain 0-2000 m

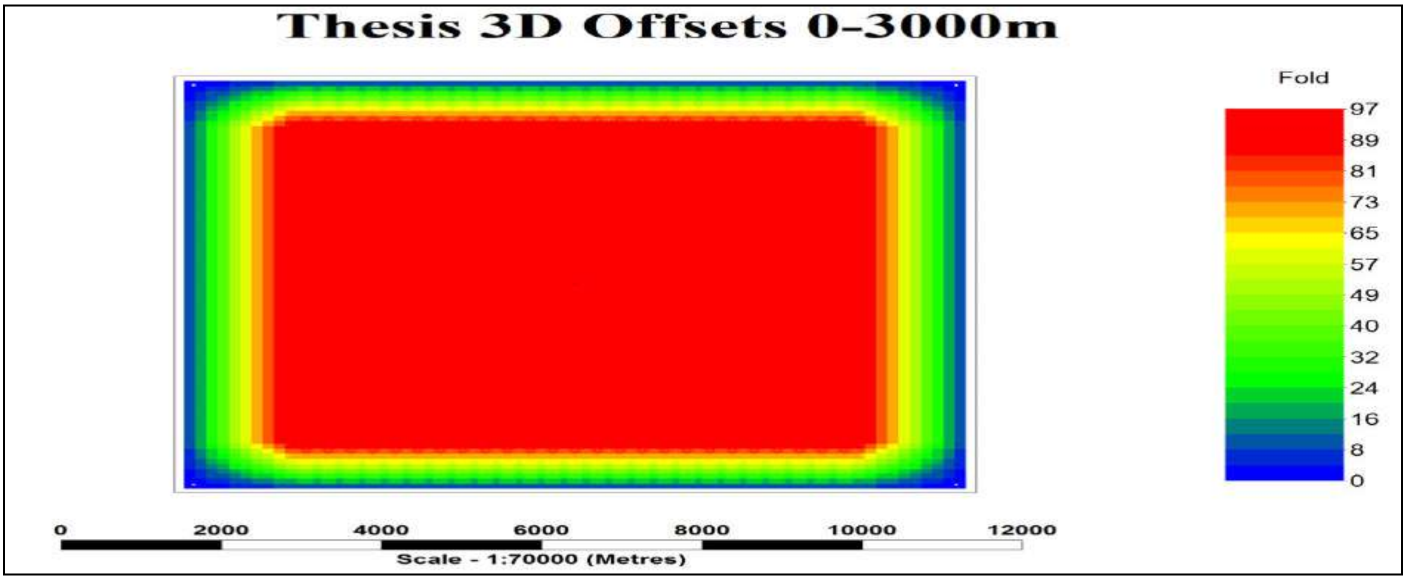


Fig 8 Fold Distribution in Limited Offset Domain 0-3000 m

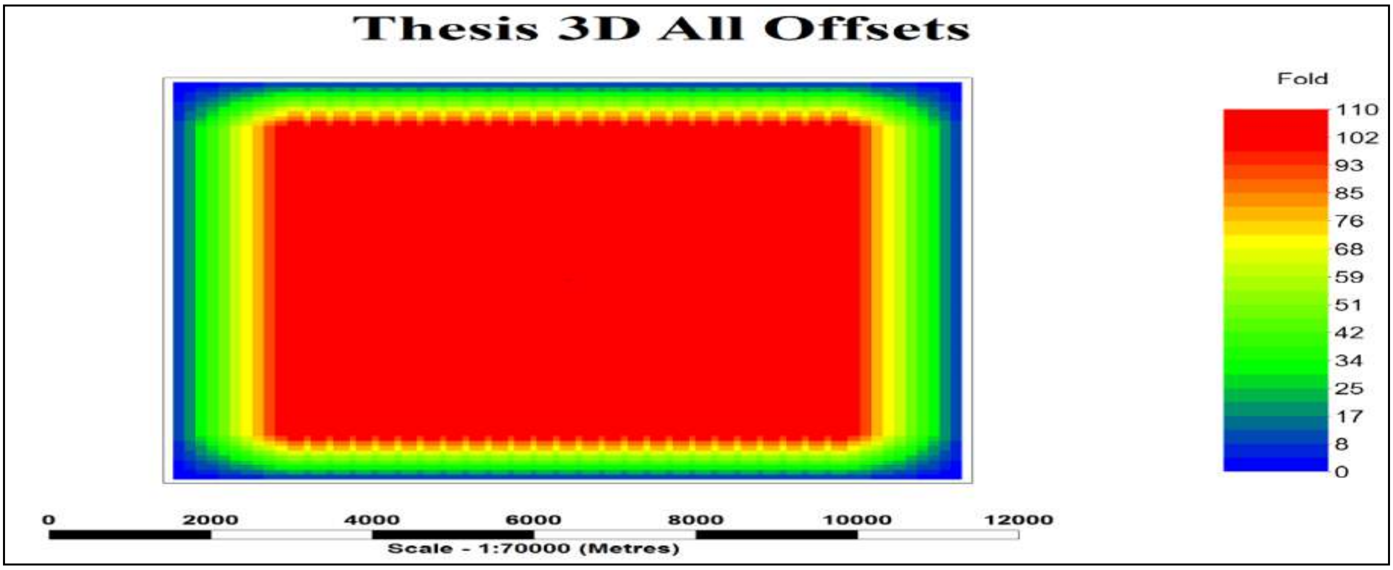


Fig 9 Fold Distribution Including all Offsets – Total Fold

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

➢ *Fold*

The number of midpoints that are stacked within a CMP bin. Stacking fold (or fold-of-coverage) is the number of field traces that contribute to one stack trace, i.e., the number of midpoints per CMP bin. It is also the number of overlapping midpoint areas. Fold controls the signal-to-random noise ratio (S/N). If the fold is doubled, a square root of two (41%) increase in S/N is accomplished. Doubling the S/N ratio requires quadrupling the fold, assuming that the noise is distributed in a random Gaussian fashion. Fold should be decided by looking at previous 2D and 3D surveys in the area, through evaluating *X*min and *X*max (Cordsen, 1995b), by modeling.

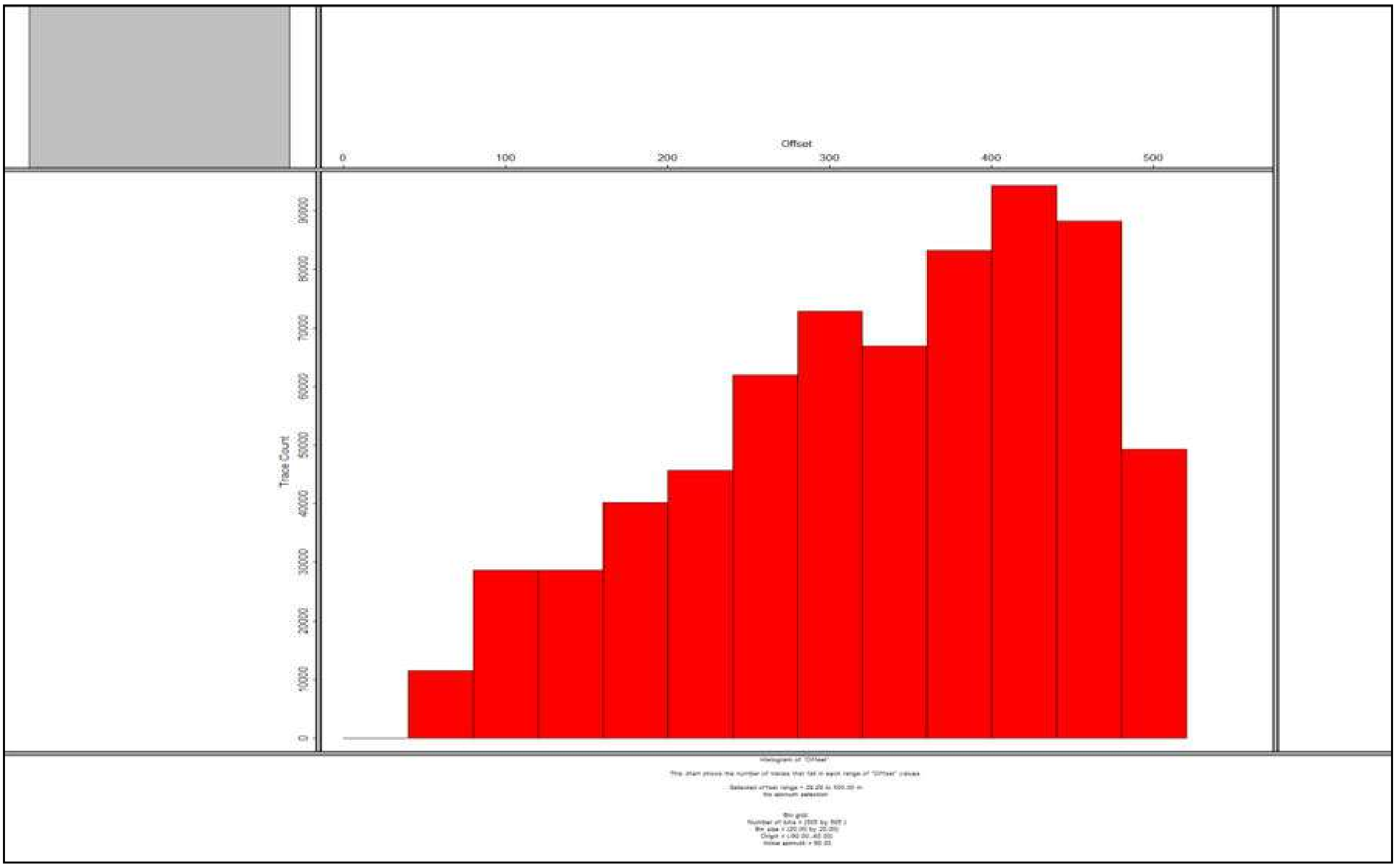


Fig 10 Offset Distribution of the 3D Survey.

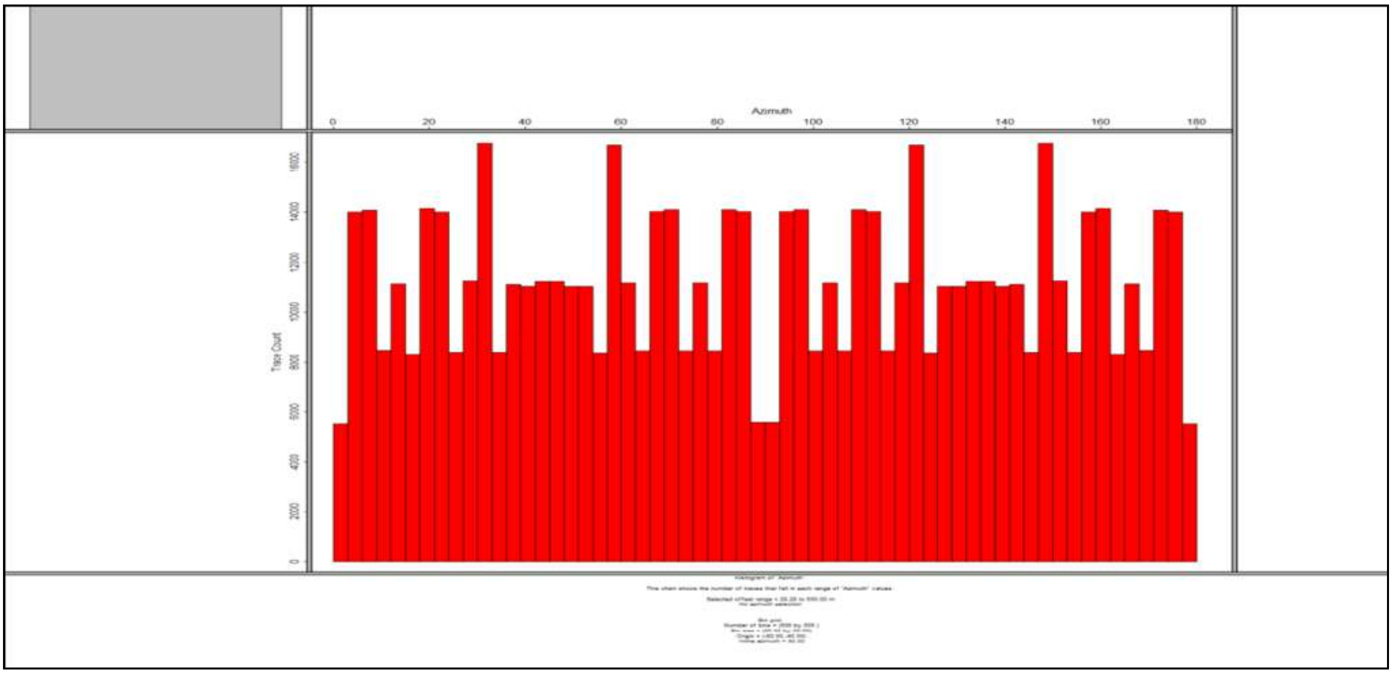


Fig 11 Azimuth Distribution of the Seismic Traces.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

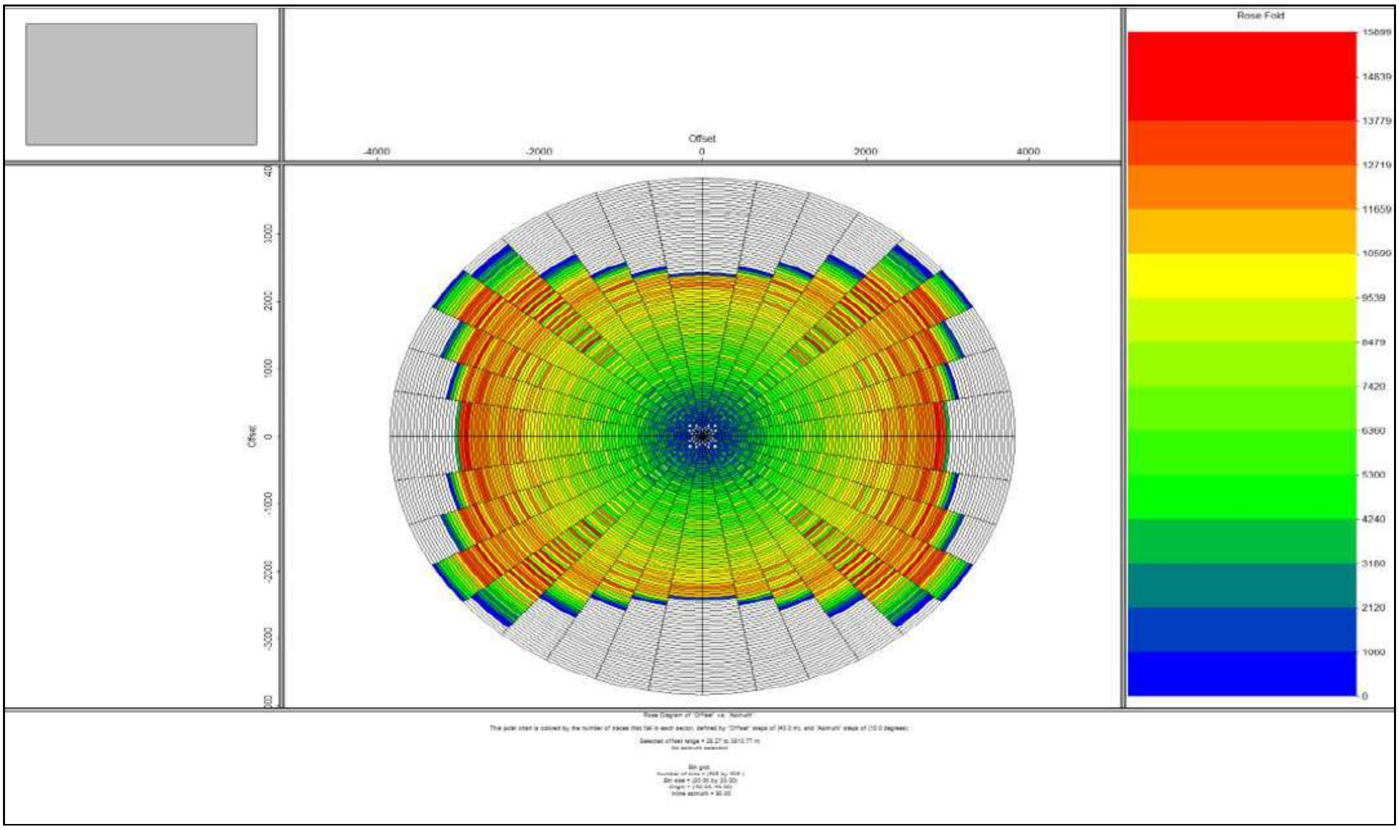


Fig.12 Fold as Function of Offset and Azimuth of the 3D Survey (Rose Diagram)

➢ *Acquisition Parameters*

The recording parameters are important in data acquisition as they determine and influence the depth of target and resolution. Keeping this goal and the cost consideration in mind, we have to specify parameters such as:

- Source and receiver spacing
- Source line (SL) and receiver line (RL) interval
- Active channels per patch
- Sweep length
- Number of vibrators per source point.
- Number of geophones per receiver point
- Record length
- Types of recording (flip-flop, simultaneous, slip-sweep)

➢ *Time Sampling*

In the 60's industries changed from recording continuous analog signal to recording digital data sampled at a fixed time interval. This revolutionized the ability to process seismic data for signal enhancement.

The seismic data is sampled at a discrete time interval called sample interval or sample rate. The sample rate varies by data set most commonly it is 2ms, but can be 4ms or 1ms depending on the business need (the structural target, velocity, depth and the resolution needed) and the instrument use.

➢ *Space Sampling*

The selected spatial sampling is also influenced by the depth of exploration target zone: wide space interval can be used for deeper targets (20-50m) and close interval (5-10m) is mostly used for shallow target. The spatial interval influences the resolution also.

➢ *Source Parameter*

The source parameter defines the amount of energy that is send into the subsurface, they include the band width, the start frequency and end frequency which in the scope of this work ranges usually from 6-120Hz, the number of sweep 1-4, the sweep length, the number of vibrator used, the charge weight of the explosive, the depth hole, the peak force of the vibrator and vibrator drive. These parameters sum up to give the energy of the source and it influences the signal to noise ratio the higher the energy the higher the S/N. Wide band width increases the resolution also high frequency provides a higher seismic image resolution.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Consequently low frequency penetrates deeper. We can see in below the summary of source parameter of the 2D and 3D data from Survey 1. (2D survey) and Survey 2. (3D survey) respectively which was used for this thesis work. To determine the source strength of the different (vibrator and explosives) the following rule can be used.

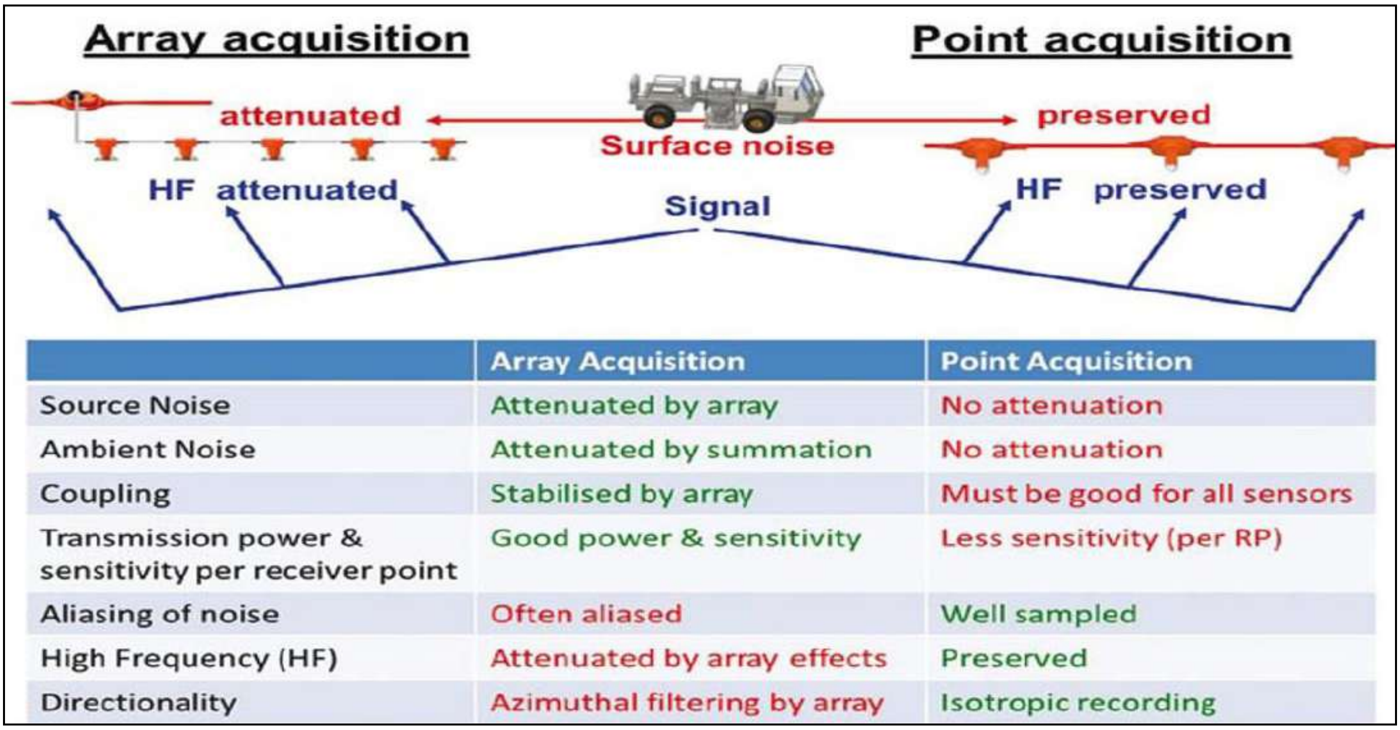
Vibrator	
$SS=Pf\times D\times Nv\times\sqrt{Sl}\times\sqrt{Ns}$	**SS: Source Strength**
	Pf: vibrator peak force
	D: drive level
	Nv: number of vibrators
	Sl: sweep length **Ns: number of sweep**
Explosive	
$SS=\sqrt{WCh\times NSh\times QCh\times QD}$	
SS: Source Strength	
WCh: Weight of charge (explosive)	
NSh: Number of shot holes	
QCh: Quality of explosive charge	
QD: Quality of dumping – (how effectively the charge is dumped underground)	

➢ *Source and Receiver Array*

This is the geometrical configuration of the sources (a source array, with each individual source being activated in some fixed sequence in time) and or receivers (a hydrophone or geophone array) that is recorded by one channel in the seismic acquisition. By using arrays of sources and receivers, we can reduce unwanted, horizontally propagating noise in the near surface while reinforcing the vertically traveling seismic energy (down from source array and up from the subsurface refection).

Fig 13 Vibrator Source Array in the Field Ready for Recording.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175



	Array Acquisition	Point Acquisition
Source Noise	Attenuated by array	No attenuation
Ambient Noise	Attenuated by summation	No attenuation
Coupling	Stabilised by array	Must be good for all sensors
Transmission power & sensitivity per receiver point	Good power & sensitivity	Less sensitivity (per RP)
Aliasing of noise	Often aliased	Well sampled
High Frequency (HF)	Attenuated by array effects	Preserved
Directionality	Azimuthal filtering by array	Isotropic recording

Fig 14 Set of Receiver Array Compared with Point Receiver Option in the Field

➤ *Advantages of Geophone Array:*

- Filtering of ambient noise
- Increasing of signal amplitude
- Filtering of coherent noise

- *Usually the Number of Geophone Per Channel:*

N ≈6, 12, 24 geophone /channel

Array length: 1 ≑2 x ΔG

WhereΔG - geophone station interval

Record Length: $T=2\ H_{max}/V + 0.5 \doteqdot 2$ sec

- Shallow water, coal, bauxite exploration: 0.5 – 1 sec
- HC, geotermal exploration: 4 – 6 sec
- Earth core exploration: 12 sec
- Mantel exploration: 24 – 30 sec

➤ *Seismic Data Acquisition.*

The field data for this thesis work is a 2D seismic data from Survey 1. and 3D seismic records from Survey 2.
Below are the recording parameters listed used in the acquisition of the two surveys:

- *2D Field Geometry and Recording Parameters*

✓ Receiver Point Interval 20 m
✓ Source Point Interval–vibroseis 20 m
✓ Source Point Interval–dynamite 20 m
✓ Number of Active Channels per Line 360
✓ Nominal Full Fold 180 at vibroseis and dynamite
✓ Start/End of line Roll On / Roll Off

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

- *Vibrator Source*

- ✓ Vibrator type AHV-IV.
- ✓ Vibroseis (80%) 2 set x 3 vibs + 1 spare
- ✓ Number of Sweeps per VP 3 vibs x 1 sweep
- ✓ Sweep Length 20 seconds
- ✓ Sweep Frequencies 6 - 110 Hz Linear
- ✓ Source Array Length 12, 5 m
- ✓ Vibrator Move-up No move-up
- ✓ Begin / End Sweep Taper (ms) 300 ms

- *Dynamite Source*

- ✓ Source I. pop shot; holes per SP 3
- ✓ Charge weight 0, 5 kg
- ✓ Charge depth 3 m
- ✓ Source II. Single hole 1
- ✓ Charge weight 1, 5 kg
- ✓ Charge depth 5m Receivers
- ✓ Geophones Sensor SM 24, 10 Hz, 70% damping
- ✓ Number of Geophones per Station 12
- ✓ Geophone Array Type In-line
- ✓ Geophone Array Length 18, 33 m Recording Parameters
- ✓ Recording System SERCEL 428/408
- ✓ Record Length 5 s
- ✓ Sample Rate 2 ms
- ✓ Recording Format SEG D
- ✓ Anti-alias filter 208 Hz, linear phase

Table 3 3D Field Geometry and recording parameters

3D Field Geometry and recording parameters	
Receiver Point Interval	50 m
Source Point Interval	50 m
Receiver Line Interval	200 -400 m variable
Source Line Interval	160-360 m variable
Geometry	Orthogonal, Triple Staggered
Number of Active Lines	20
Number of ActiveChannels per Line	160
Total Number of ActiveChannels	3200
Nominal Full Fold	110
Source Points per Salvo	4 - 8
Start/End of 3D Spread	Roll On / Roll Off
Vibrator Source	
Vibrator type	AHV-IV. INOVA
Vibroseis (80%, ground force, 12 m distance pad to pad)	2 set x 2 vibs + 2 sp 2 set x 3 vibs + 1 sp
Source Point Density	83,8 / km2
Theoretical Total Number of SourcePoints	21 000
Source line km-s	1 050
Number of Sweeps per VP	
Source1. (urbanares)	1 vib x 4 sw
Source2.	3 vib x 2 sw
SweepLength	18 seconds
SweepFrequencies	8 - 96 Hz Linear
SourceArrayLength	25 m
VibratorMove-up	No move-up
Begin / End SweepTaper	300 ms
Source Line Azimuth	198 degrees
Receivers	

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Geophones	Sensor SM-24,10 Hz, 70% damping
Number of Geophones	1 string per station
Geophone Strings	6 phones per string
Geophone Array	2 m x 1 m box car shape

Recording Parameters

Recording System	GEOSPACE GSR wireless telemetry
Record Length	5 s
Sample Rate	2 ms
Recording Format	SEG D
Anti-alias filter	208 Hz, min. phase

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

CHAPTER THREE
SEISMIC SIGNAL AND NOISE

➢ *Seismic Signal and Noise*

When the seismic waves are generated by the source points, they travel through the subsurface, we wish to detect the mechanical motion of the ground and convert the motion into an electric signal. Then the electric signals are taken via cables to the recording instrument. There is also wireless system which does not require cable transmission and recording truck. Unfortunately, besides the useful seismic reflection signals, we also record many other interactions such as multiples and different seismic noises.The recorded data then passes through different processing steps e.g. (De convolution, Stacking, Filtering and Migration) until the noise is suppressed and a seismic image is obtained as final product.

➢ *Seismic Noise Analysis and Classification*

Noise usually contaminates seismic data so sometimes we get unwanted features in them which affect the reliability of the seismic data that provides a better understanding of the reservoir characteristics. Subsequently, it is dependent on the quality of the records and the signal to noise ratio - S/N - which is the ratio of the signal energy in a portion of the record to the total noise energy in the same portion. Poor records obviously results whenever the signal to noise ratio is small.

The Noises commonly associated with seismic data can be classified as; Coherent noise Random noise or Incoherent noise.

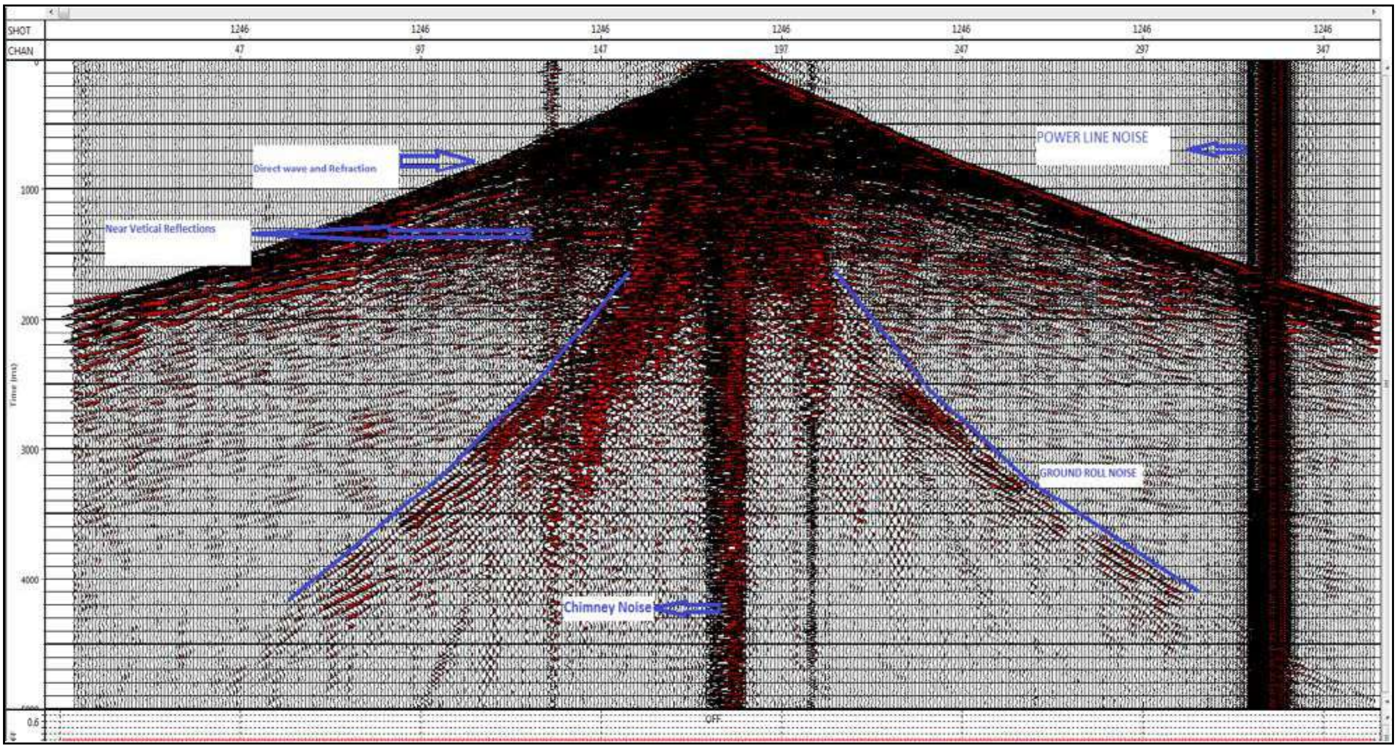


Fig 15 Different Noises Associated with One of the Seismic Record using Vibrators at Frequency (8-120Hz)

➢ *Coherent Noise*

Coherent noise includes source generated noises like surface waves, refractions or reflected refractions from near surface structures such as faults planes or buried stream channels, also noise caused by vehicular traffic or farm tractors and so forth. The most problematic coherent noise is the source generated coherent noise, i.e. the ground roll. All the noises except multiples travel horizontally and all except vehicular noise are repeatable on successive shots. Ground roll is identifying by its low frequency, strong amplitude and low group velocity. We try to eliminate ground roll in the field by the array forming of the receivers and sources. Cable noise is another form of coherent noise which is recognized by linear and low amplitude and frequency. Another form of coherent noise is the air wave which has a velocity of about 340m/s.It can be a serious problem when shooting with surface charges.

"Chimney Noise" is called the vibrator noise which is contaminates the very near offsets, typically less than 200m. It is also visible when vibrators and other vehicles are standing or moving around the active spread. It is often assumed that it is generated by the vibrator itself such as the engine of the vibrator, cooling and hydraulic systems and others.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Also, this type of noise is more critical in simultaneous vibroseis surveys because the air blast generated by one vibrator may affect several records. Coherent noise can be more challenging, and result in coherent artifacts on seismic record displays that can mask features of interpretation interest. There are two type of coherent noise:

- Coherent Noise that is not generated by the seismic source, such as the power line noise and pump jack noise
- Coherent noise that generated by the seismic source, such as ground roll, reverberating refractions and multiples

➢ *Power –Line Noise*

Power-line noise is considered a class of noise encountered in land acquisition in populated areas. It produces a characteristic 50 or 60 Hz sinusoidal noise on the traces that can be measured. Its amplitude is relatively constant with record time, whereas the seismic data amplitude decays with arrival time. Notch filters were used a long time ago to attenuate this type of noise and were often applied in the recording of the data. The notch filter would attenuate all recorded data at a given frequency, not just unwanted power line noise.

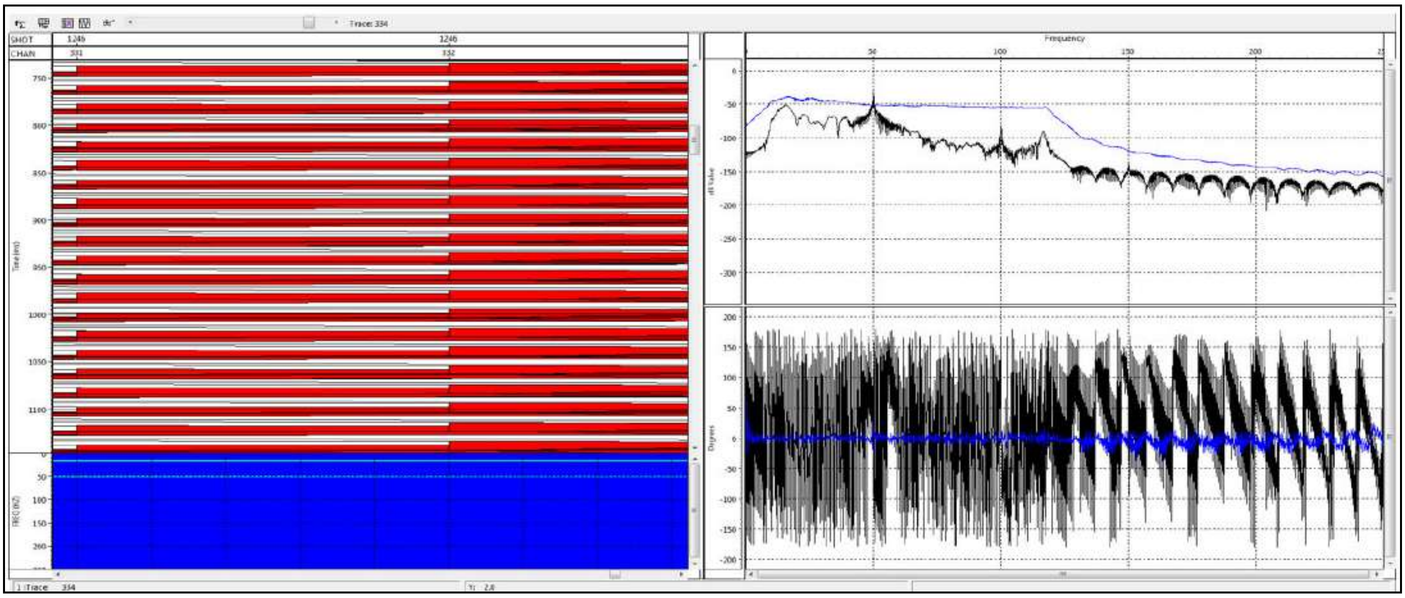


Fig 16 Power Line Effect at 50 Hz Frequency of Seismic Source Record (8-120Hz)

➢ *Random Noise / Incoherent Noise-*

Incoherent noise is often referred to as random noise, incoherent noise includes wind noise,rains, river flows, micro earthquake, vehicle/animal/people moving near the geophones etc. Random noise is the easiest to recognize and easiest to address. They generated by the activities in the environment during the acquiring data. Incoherent noise can be more challenging resulting to artifacts on seismic records that can be masked features of interpretation target. High fold coverage greatly suppresses incoherent noise on the final seismic image.

➢ *Noise Attenuation Techniques-*

Obviously, we record not only signals but also some unwanted energy coming from different kinds of sources. Though is practically impossible to eliminate completely all the noises contaminating the data during seismic processing. Hence, one of the major objectives of seismic data processing is to improve as much as possible the Signal to Noise ratio S/N ratio. The first step towards noise attenuation is to first of all to set clear the type of noise corrupting the input data and to choose suitable method of noise filtering. Table below shows the noise attenuation techniques.

Table 4 Shows the Classification of Different Type of Noise and There Possible Attenuation Techniques

Basic Noise Attenuation Techniques	
Random / Incoherent Noise	**Coherent**
Band Pass Filtering	Band pass filtering
K-filtering e.g. Trace shot summation	F-K filtering
De-spike	Muting
Stacking	Coherency filtering
Coherency filtering	F-X filtering
Editing e.g. (killing)	Notch filtering

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Land Data – Additional Type of Noises		
Noise	**Noise Type**	**Attenuation method**
Ground roll	Coherent	F-K filter
Hi-power line	Random	Kill , Notch filter
Air wave	Coherent	Hi-cut filter and surgical mute
Traffic (vehicle, people, animals)	Random	Filter , Stack, kill
Correlation noise	Random	Mute
Falling Debris	Random	Filter, Stack, kill
Wind Noise	Random	Filter, Stack, F-K filter

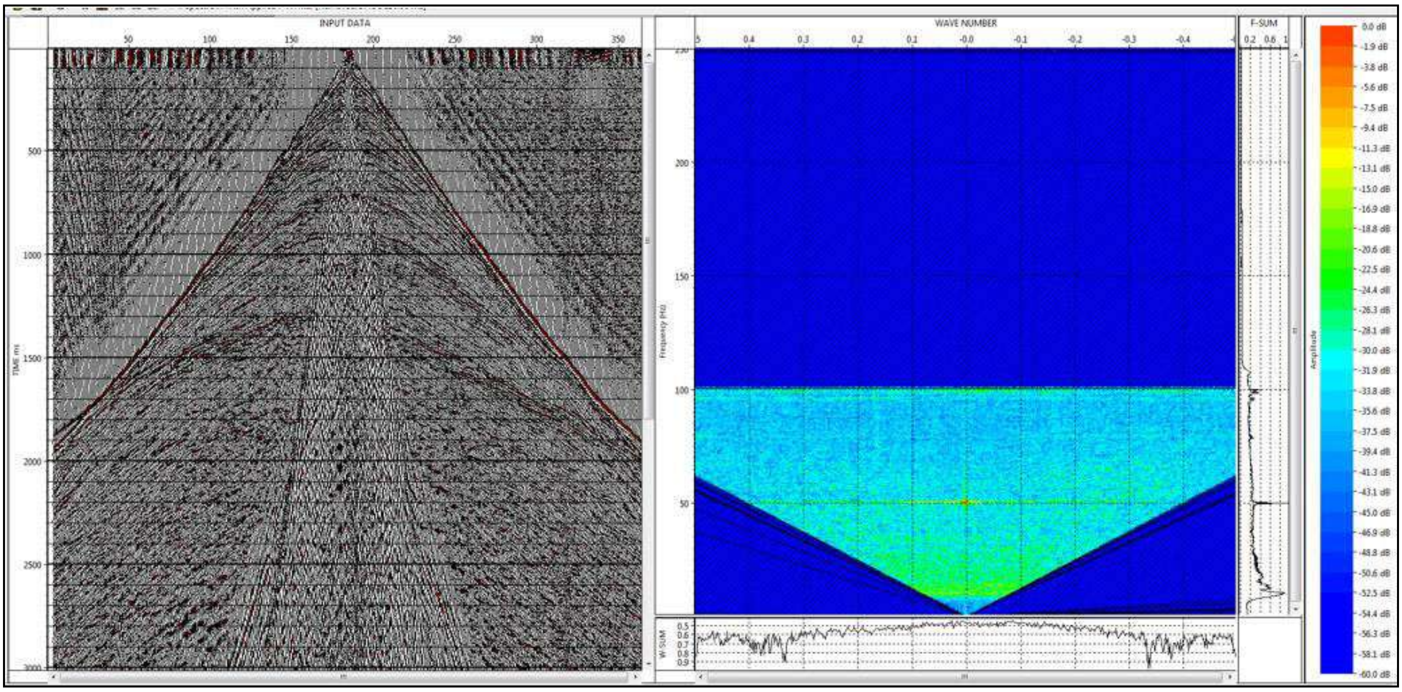


Fig 17 Seismic Field Record and its F-K Spectrum with Applying Symmetric F-K Filter

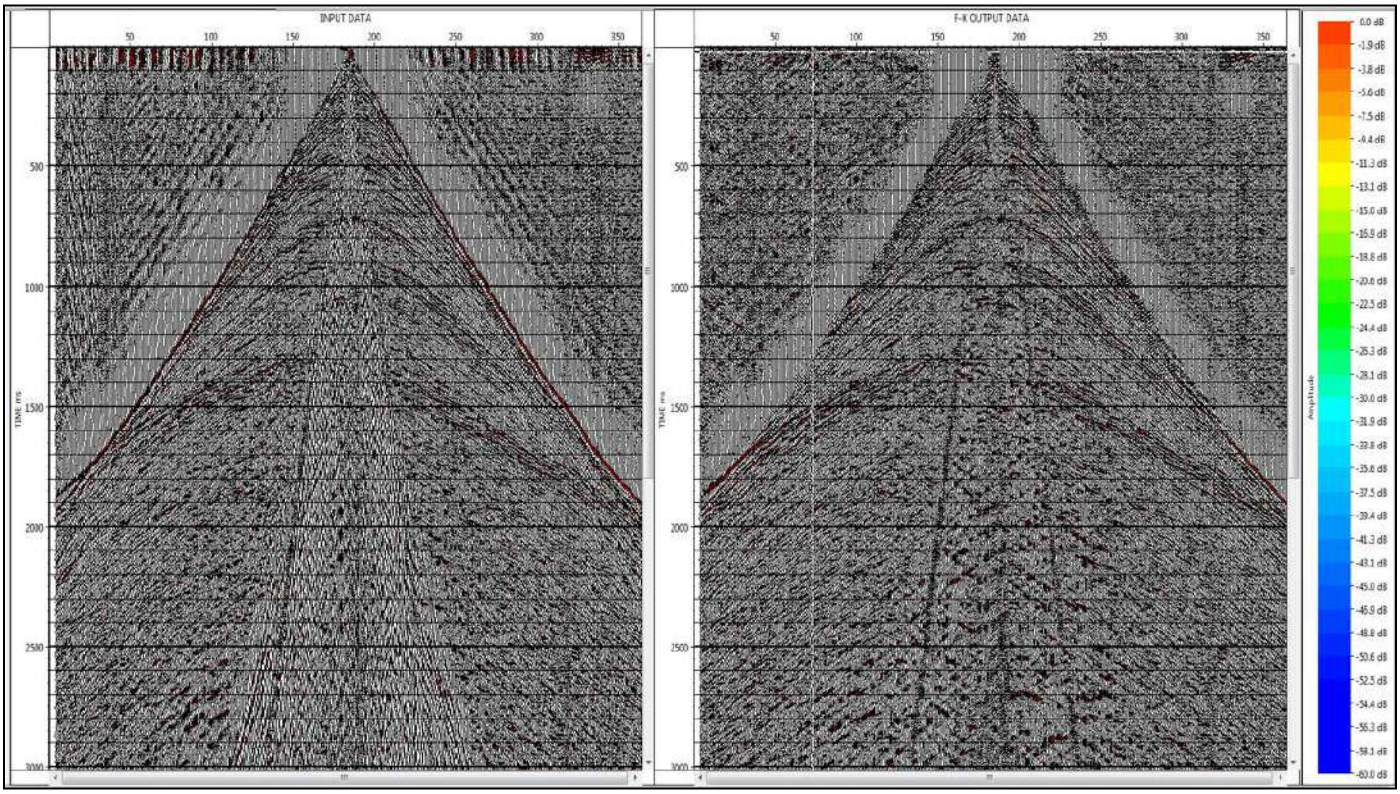


Fig 18 Seismic Field Record Without and with F-K Filtering

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

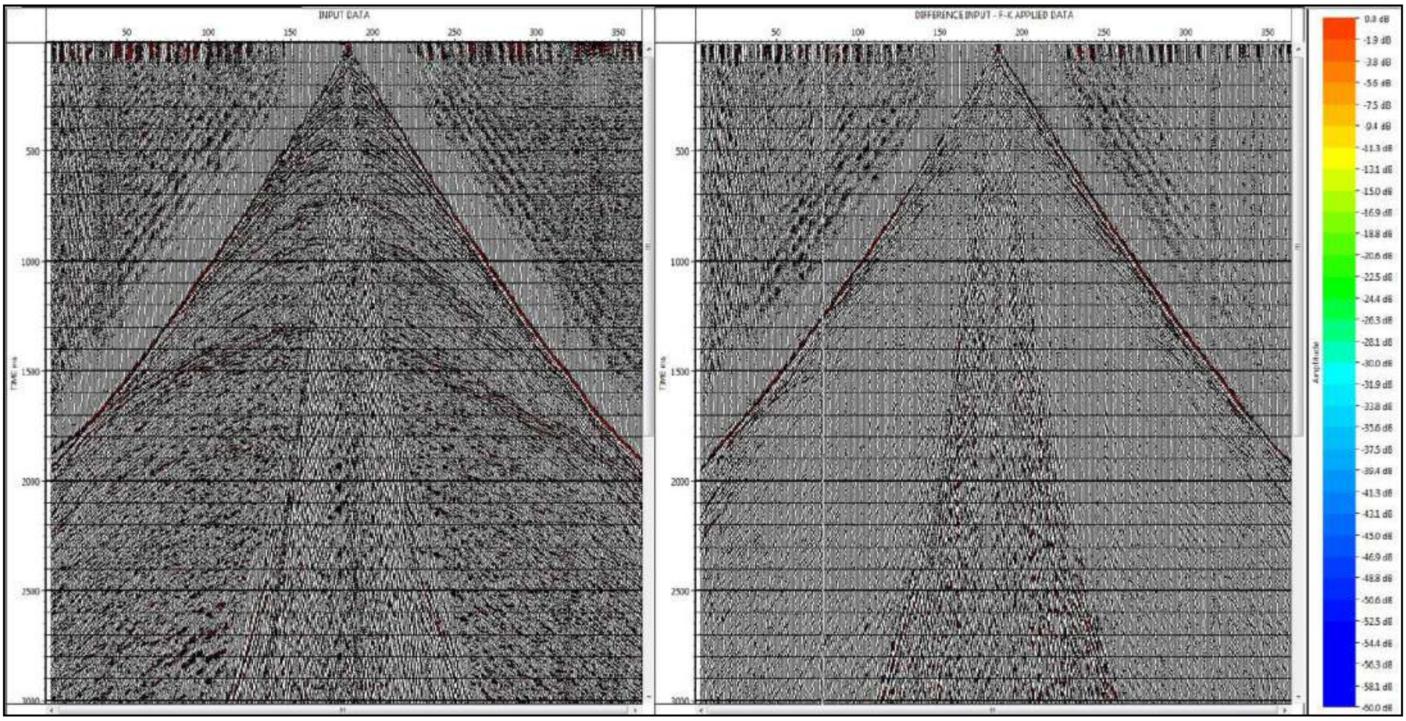


Fig 19 Seismic Field Record and the Removed Coherent Noise by F-K Filter

➢ *Spectral and Dynamic Characteristics of Signal and Some Seismic Noises.*

To be able to characterize different noises related to seismic record it is necessary to look at them from different seismic window at which they are operating, consequently I created five analyses windows for signal, ground roll noise, background noise, vehicular noise and power line noise which is present in one of the2D seismic (3m charge depth with 1kg dynamite) record for this thesis work. To show their various characteristics and to be able to known the critical noise to be affecting the signal.

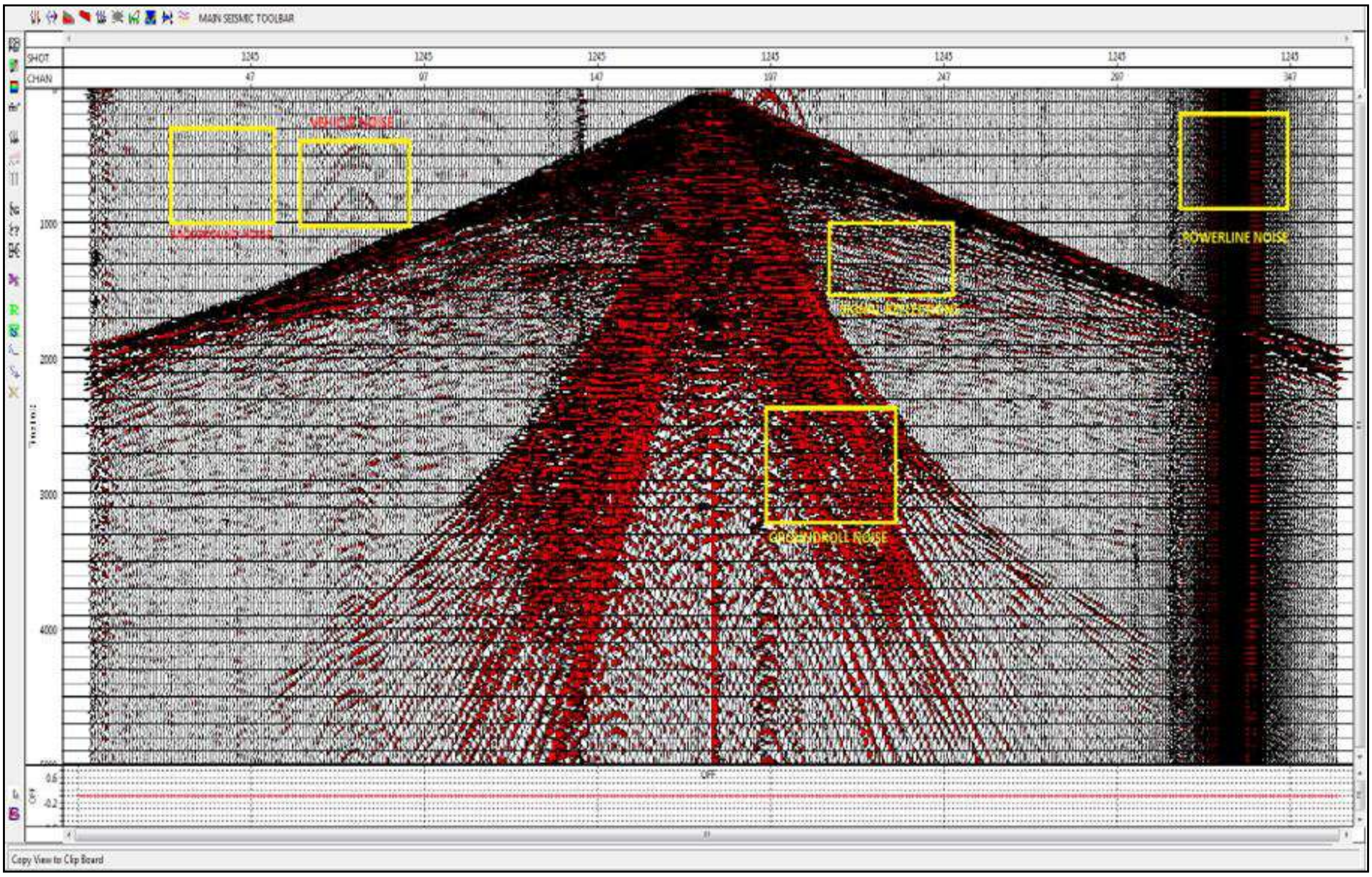


Fig 20 Displaying the Noise and Signal Windows for 2D Seismic Record

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

- *Signal Window*

This is the part of the seismic records that seems to be free from any form of noise or less noise and has good reflections. A window is chosen to know the signal energy and compare it to the energy of various noise windows. The aim is to be able to determine the critical noise from record and try to eliminate it as much as possible.

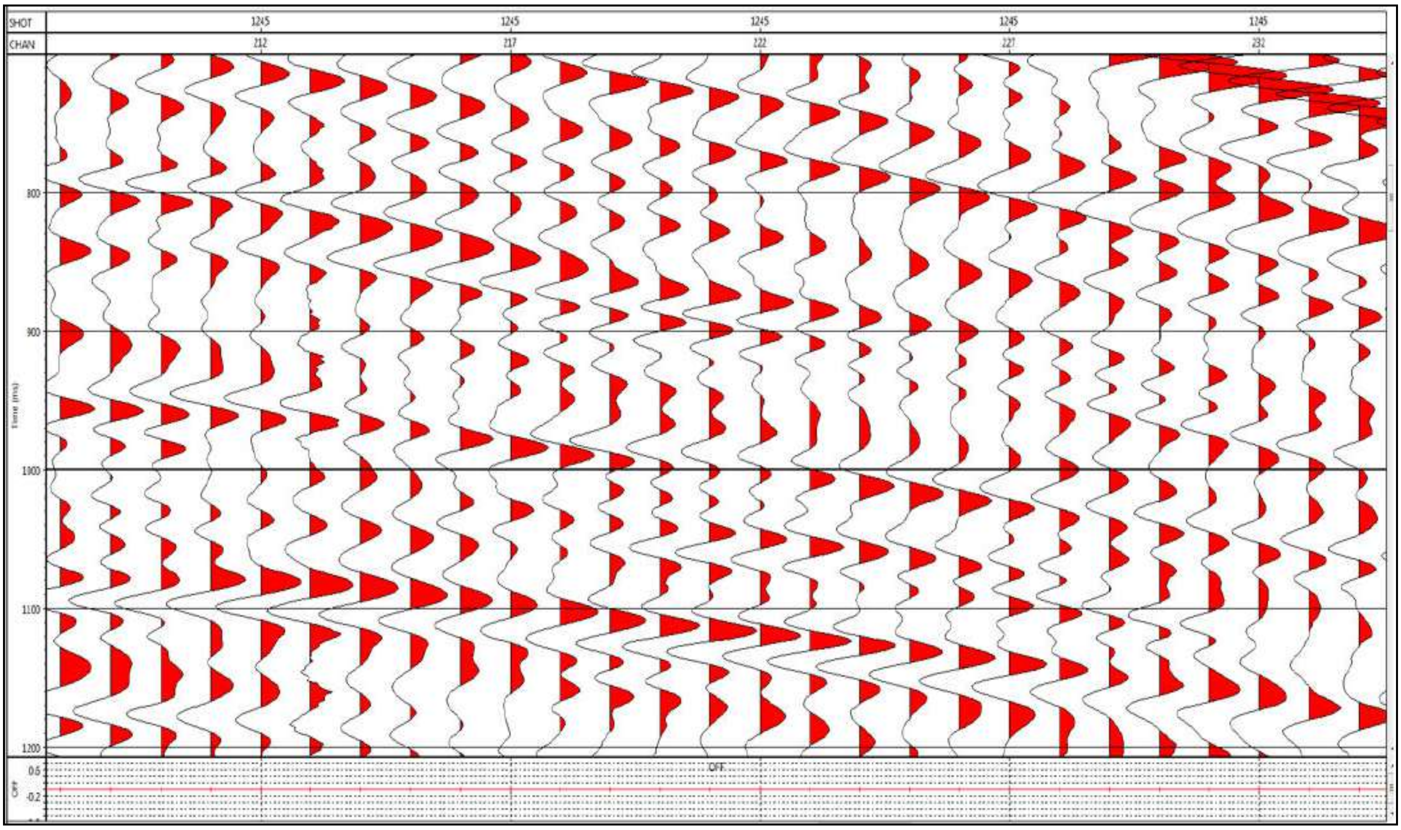


Fig 21 Zoomed Seismic Signal Window 2D (3m,1kg) Seismic Record

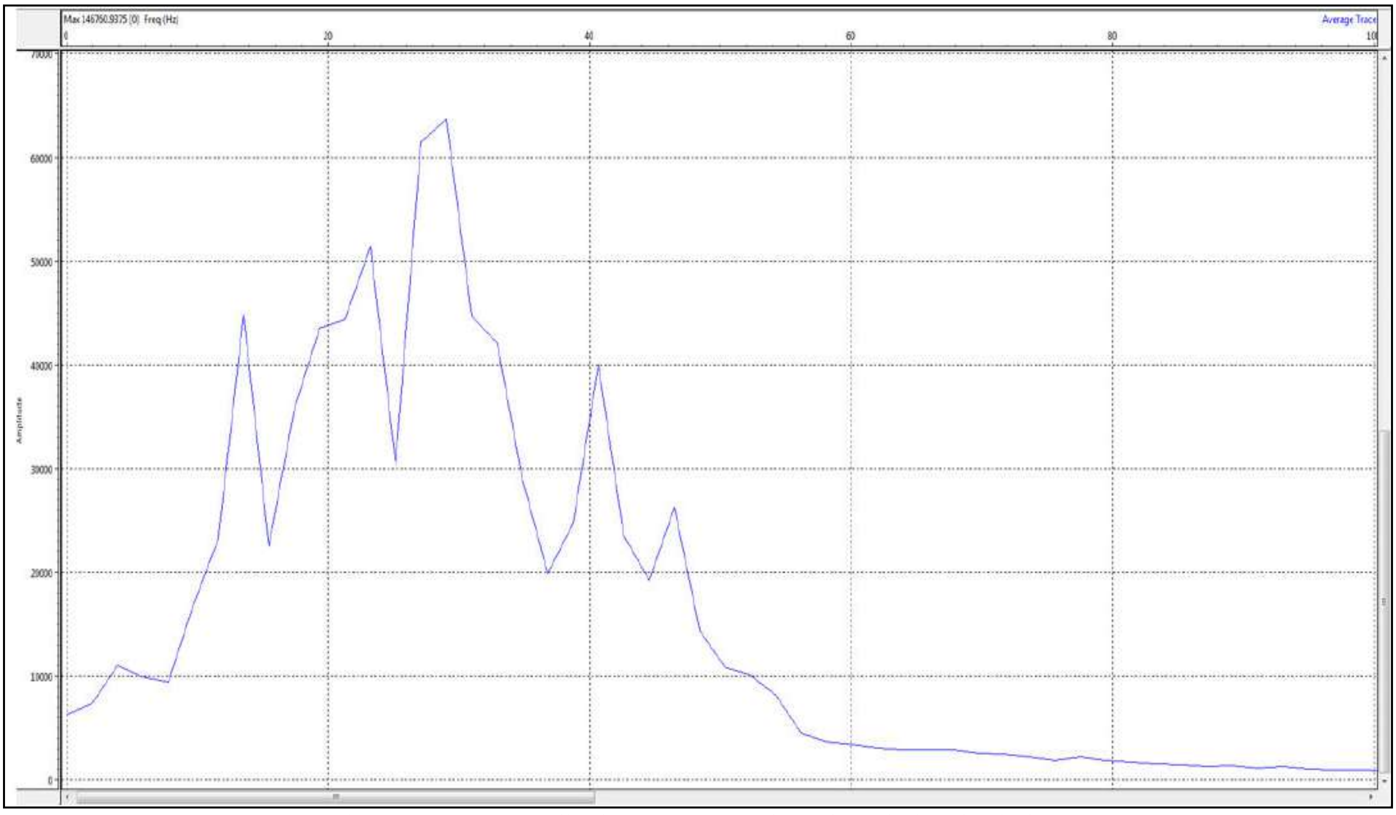


Fig 22 Average Amplitude Spectrum of the Selected Signal Window

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

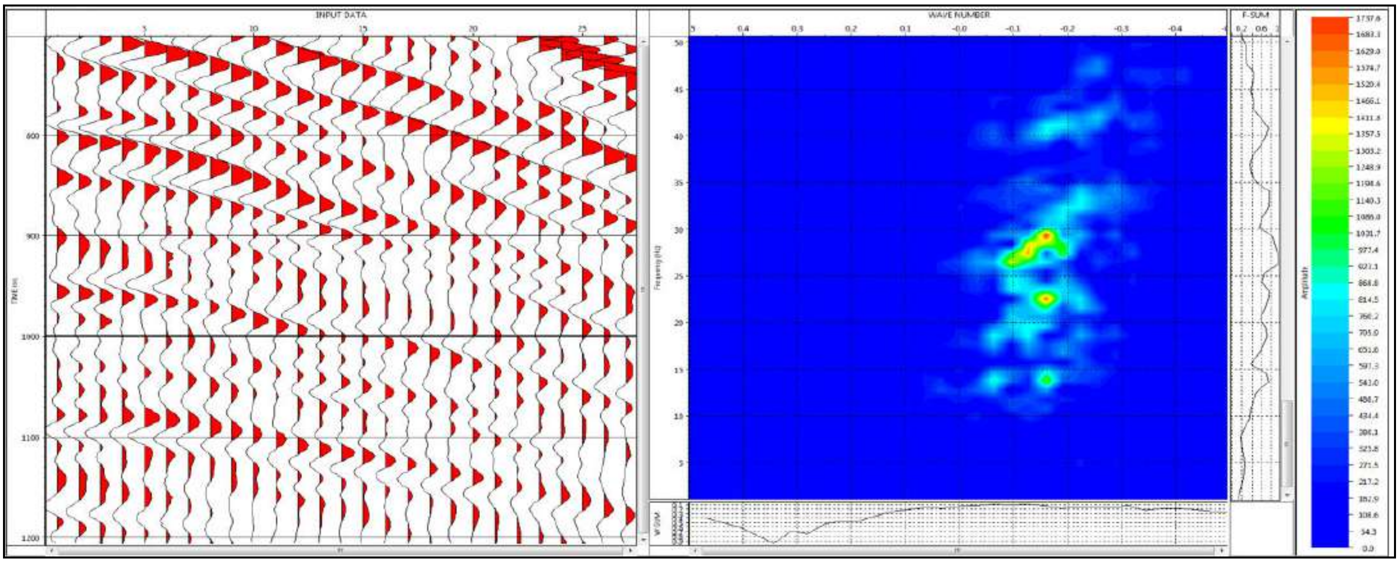


Fig 23 Linearly Scaled F-K Spectrum of the Selected Signal Window

- *Ground Roll Noise*

A window created to analyze the energy of the part of the seismic record which contains the ground roll noise. Which is a low frequency noise cause by the vibrator.

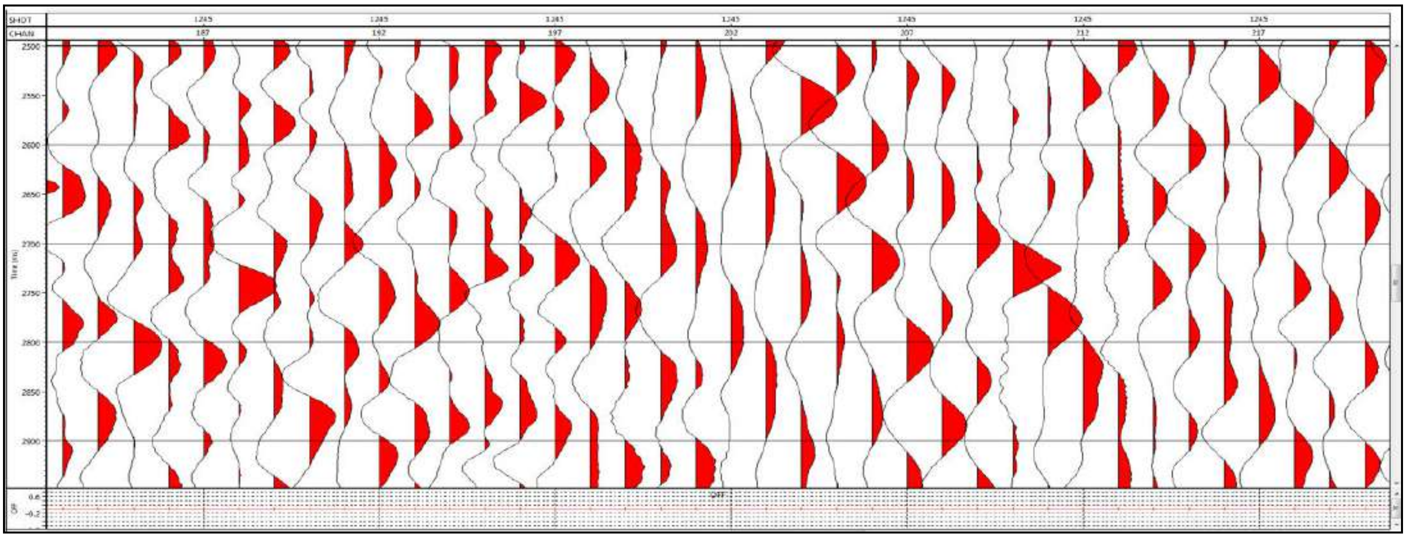


Fig 24 Zoomed Ground Roll Noise Window for 2D (3m, 1kg) Seismic Record

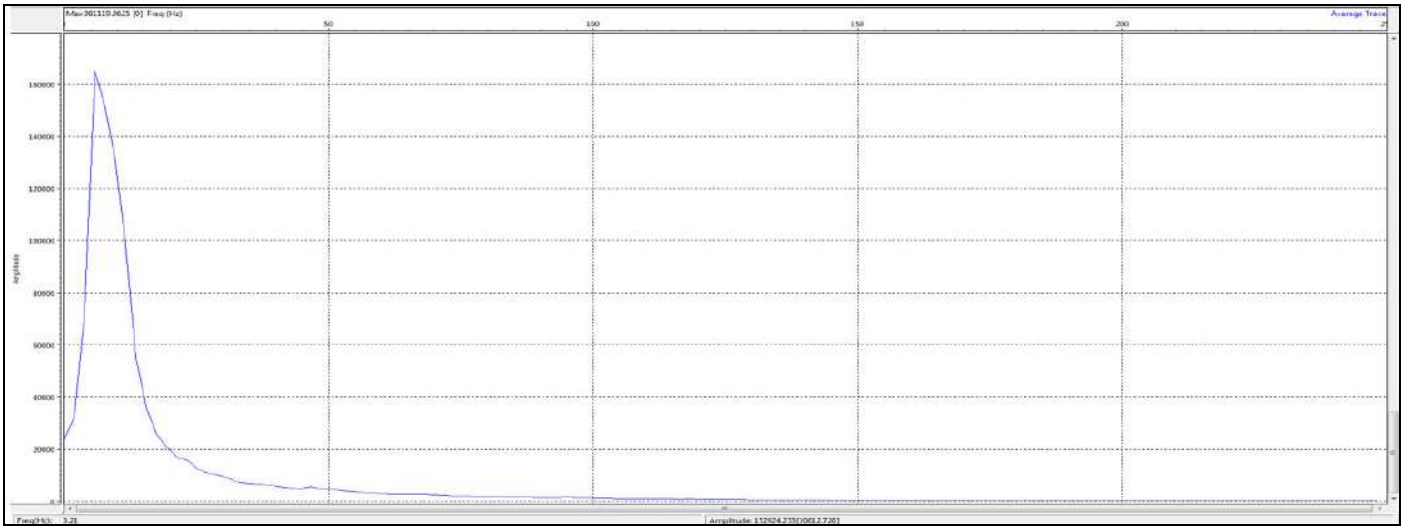


Fig 25 Average Amplitude Spectrum of Selected Ground roll Noise Window for 2D (3m, 1kg) Record

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

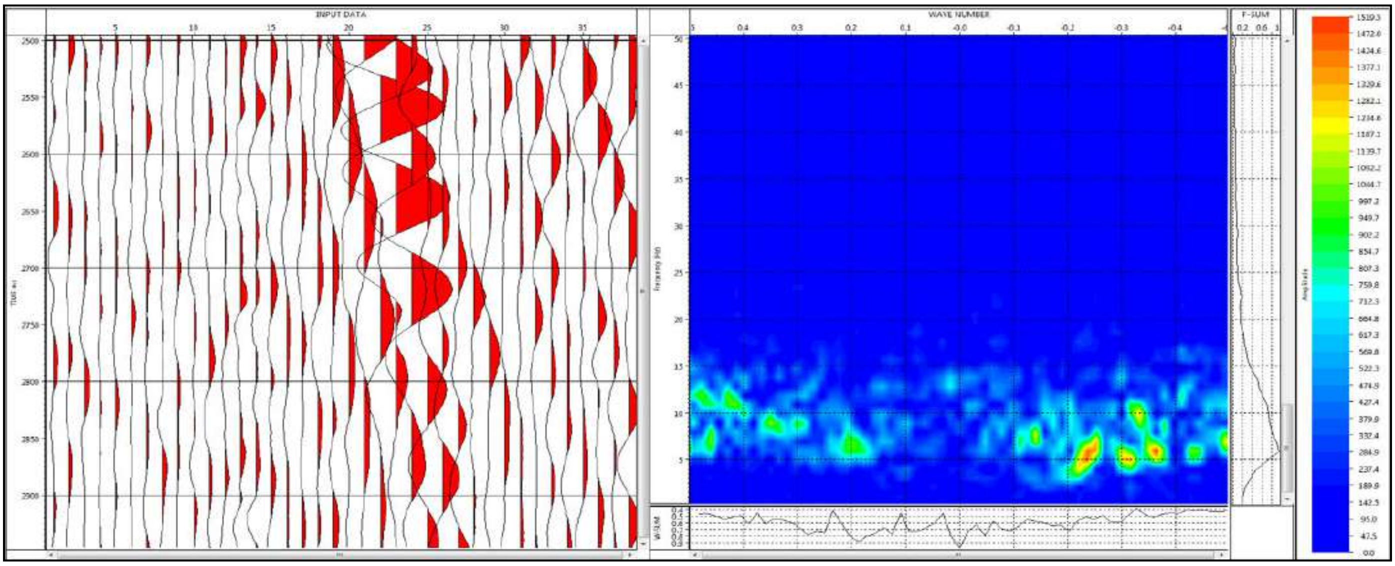


Fig 26 Linearly Scaled F-K Spectra of the Selected Ground Roll Noise Window for 2D (3m,1kg) Record

* *Power Line Noise*

The part of the seismic record which has noise which is cause by the power line tension adjacent to the receiver, it most 50-60 Hz energy noise which can be kill out or attenuated using notch filter. A window selected to determine the energy of the noise to that of the signal.


Fig 27 Selected Power Line Noise Window for 2D (3m,1kg) Seismic Record

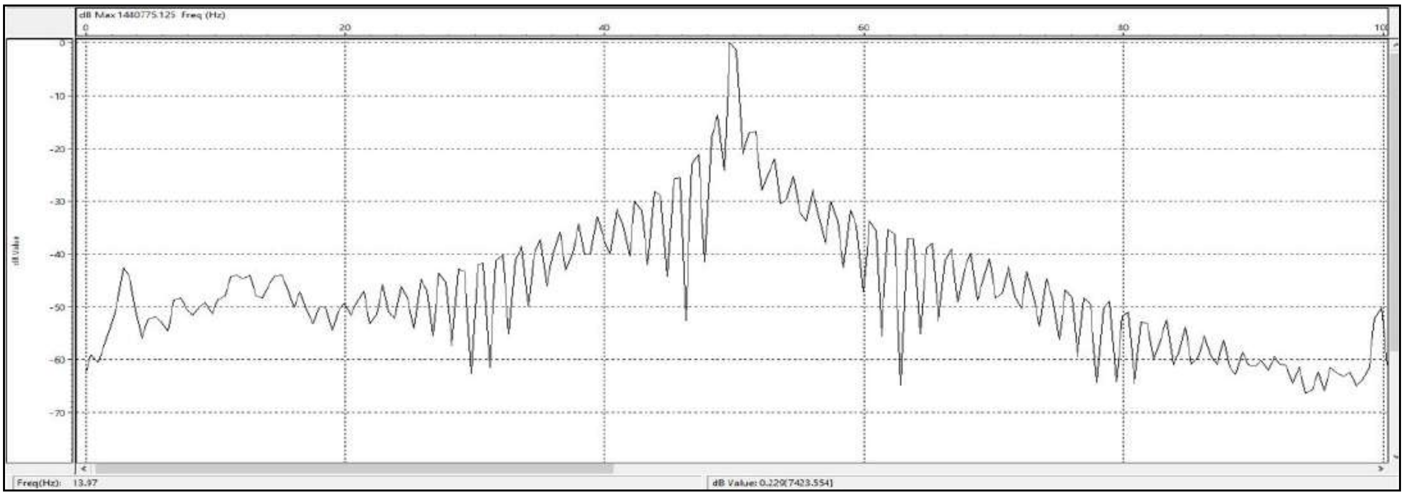


Fig 28 Average Amplitude Spectra of Selected Power Line Noise Window

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

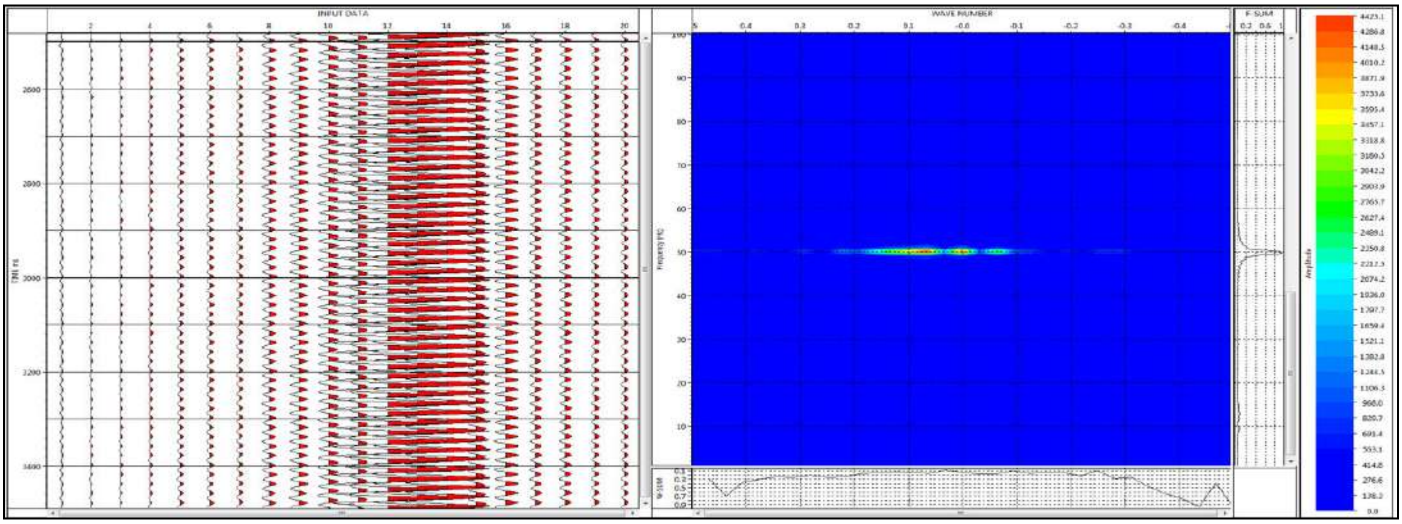


Fig 29 Linearly Scaled F-K Spectra of Selected Power Line Noise Window

- *Background Noise*

  A noise window created to analyze the effect of the background noise to that of Signal energy.

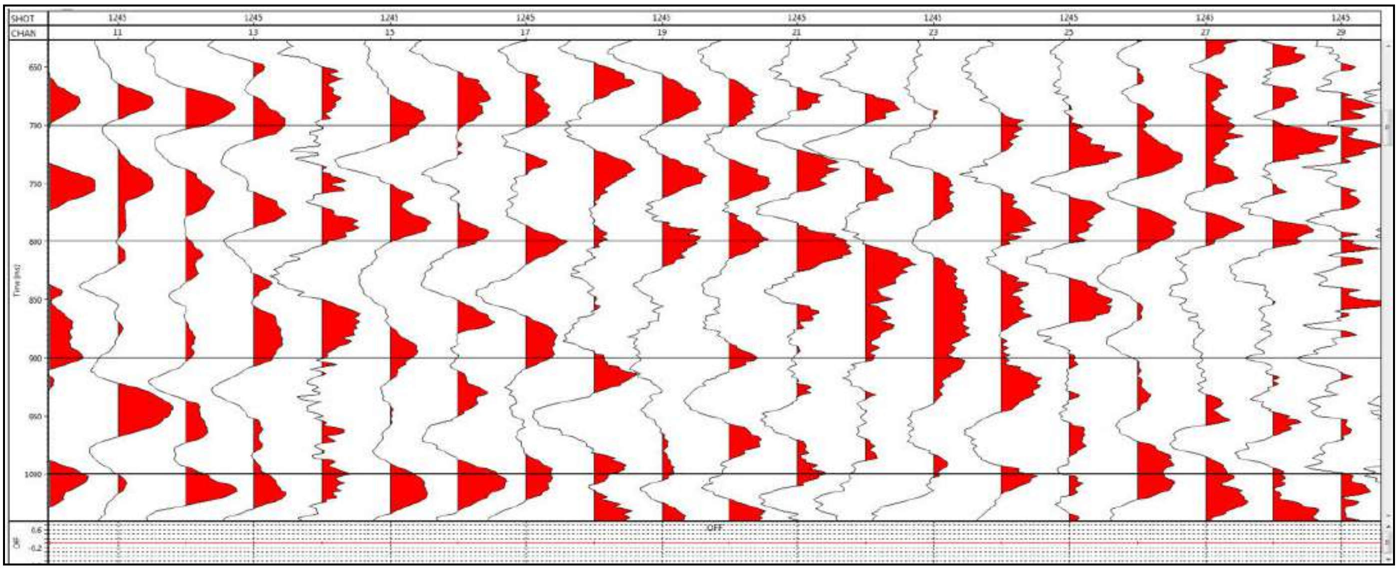


Fig 30 Selected Background Noise Window for 2D (3m,1kg) Seismic Record

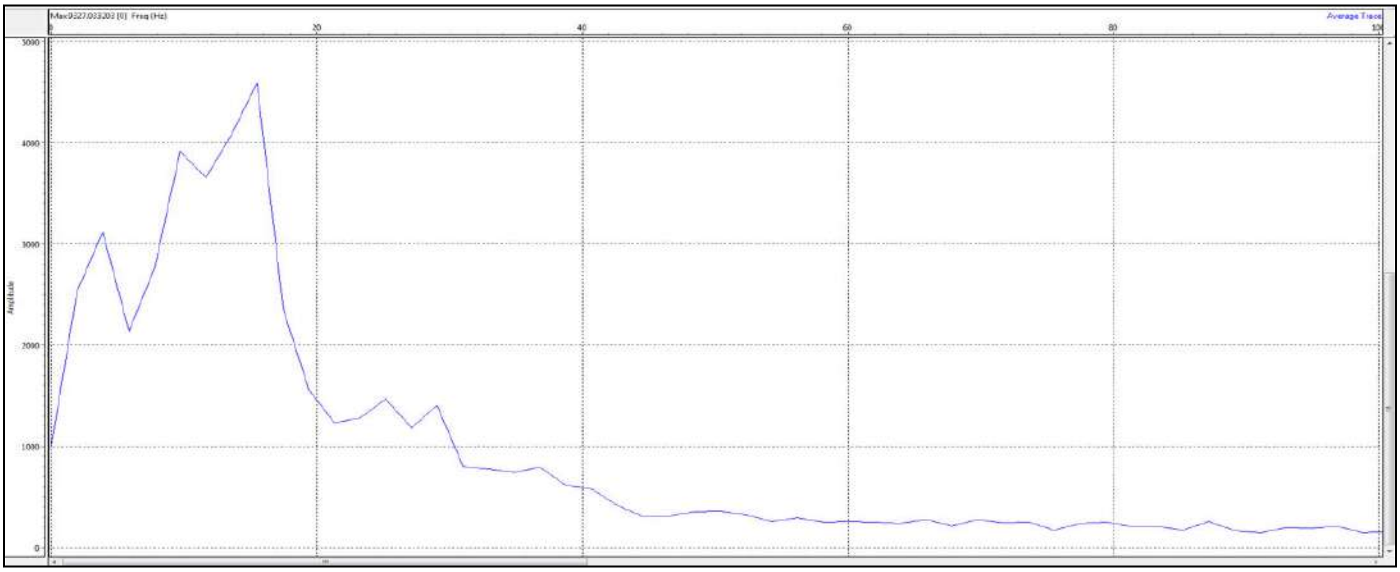


Fig 31 Average Amplitude Spectral Analysis of Selected Background Noise Seismic Window

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

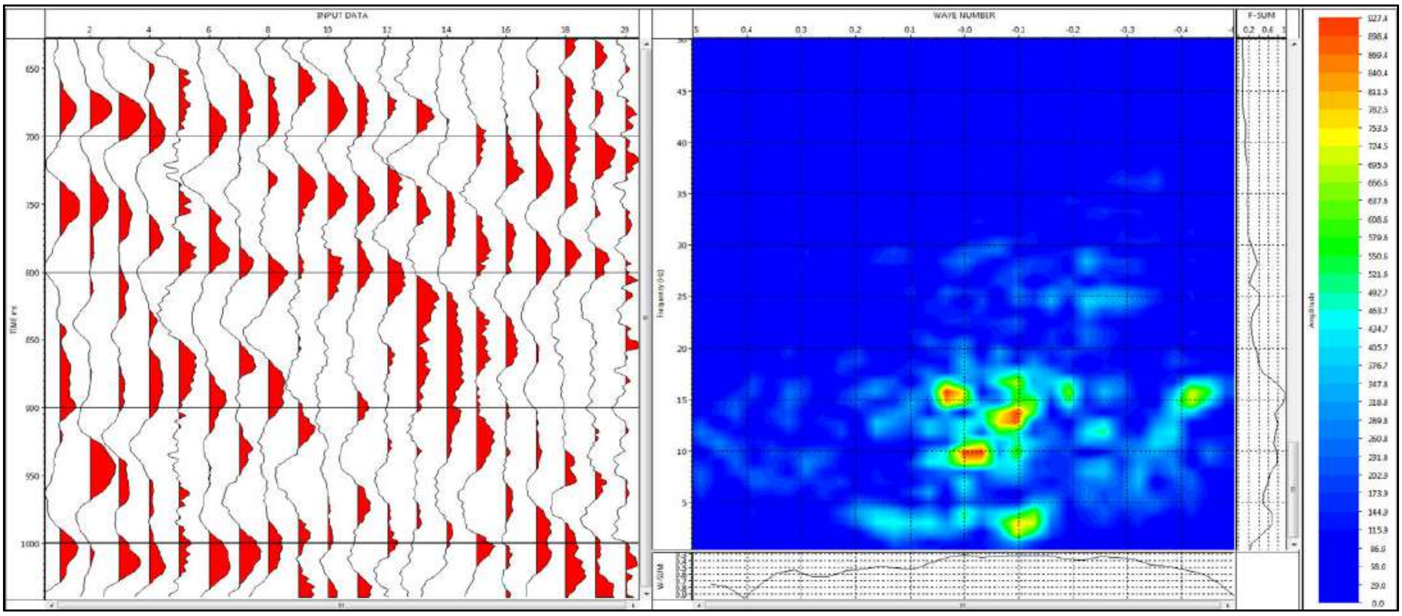


Fig 32 DB Scaled F-K Spectral Window of Selected Background Noise

- *Vehicular Noise*

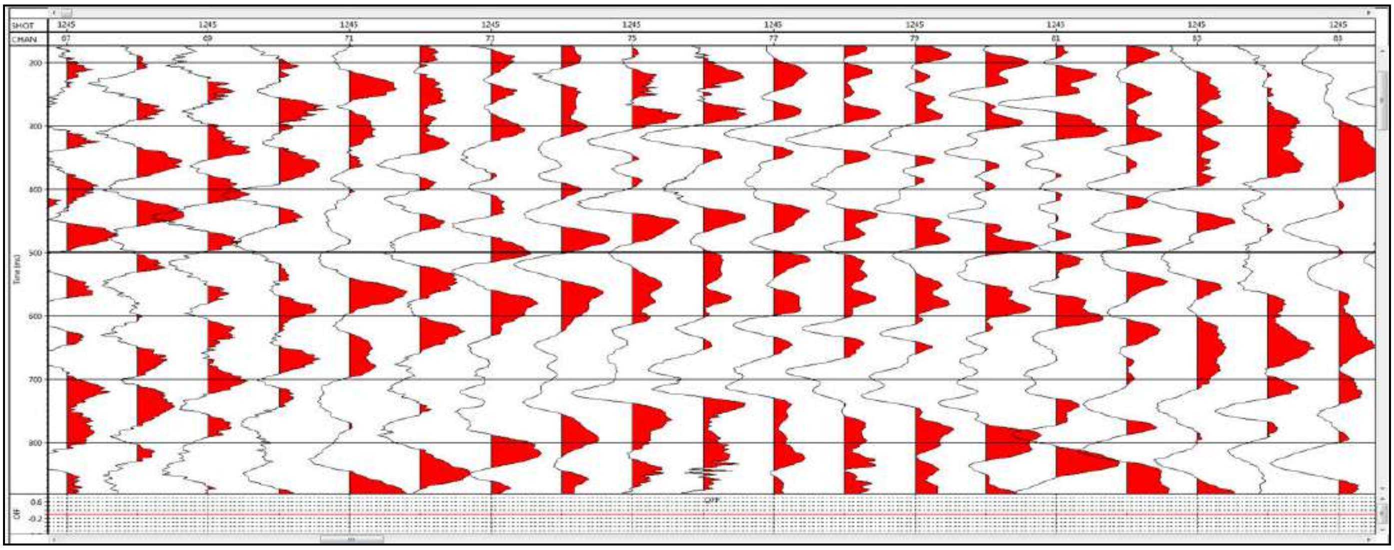


Fig 33 Selected Vehicular Noise Window for 2D (3m,1kg) Seismic Record

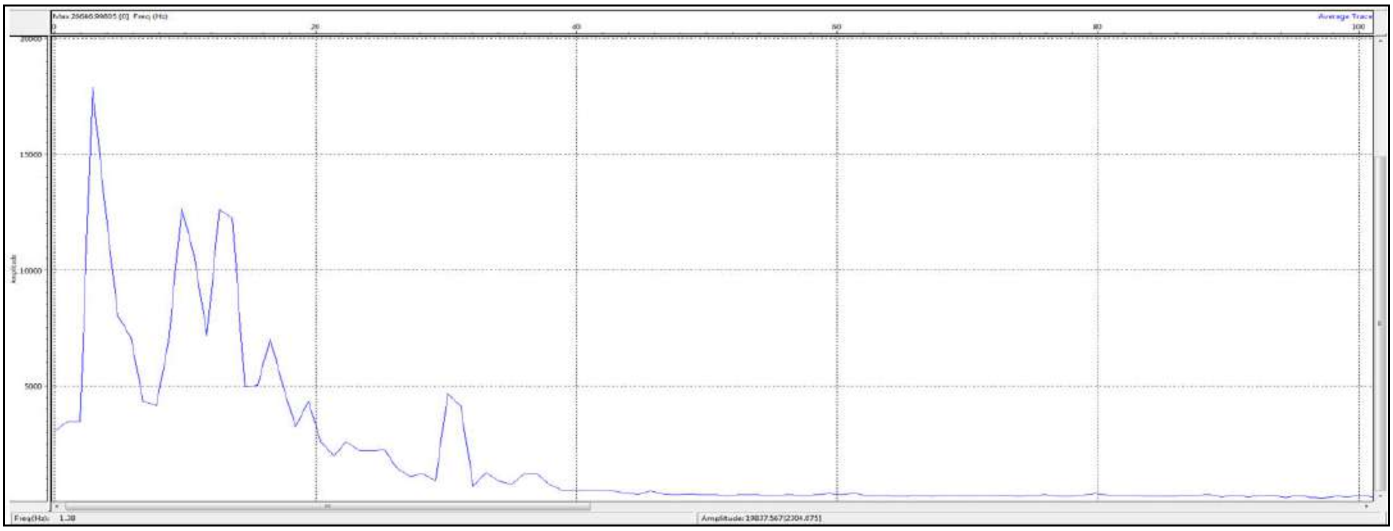


Fig 34 Average Amplitude Spectrum Analysis of Selected Background Noise Window

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

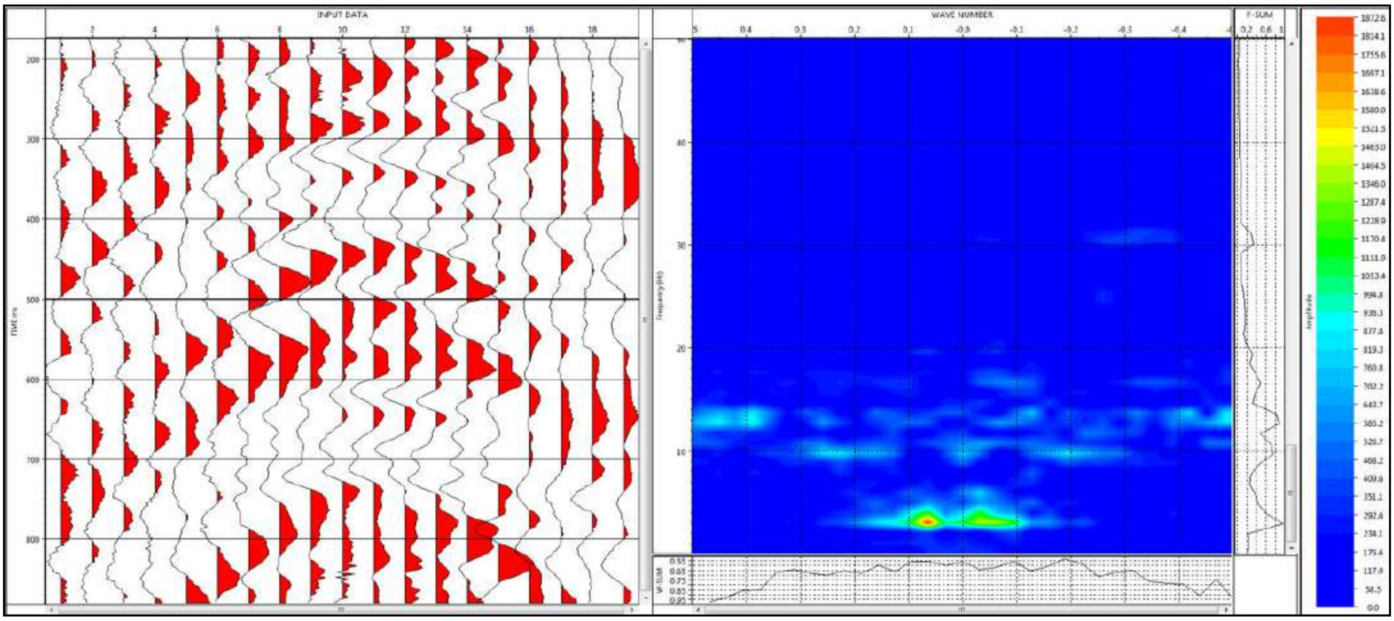


Fig 35 Linearly Scaled F-K Spectral Window of Selected Vehicular Noise

Table 5 Shows the Energy of the Various Noises to the Signal from Various Window Analyses for 2D Records

Seismic Windows	Average Energy	S/N Ratio Linear scale	S/N Ratio dB scaled
Signal	7.9E+07	N/A	N/A
Ground Roll Noise	2.3E+09	0.034	-15
Back Ground Noise	1.3E+06	61	18
Power Line Noise	2.2E+09	0.036	-15
Vehicular Noise	6.1E+06	13	11

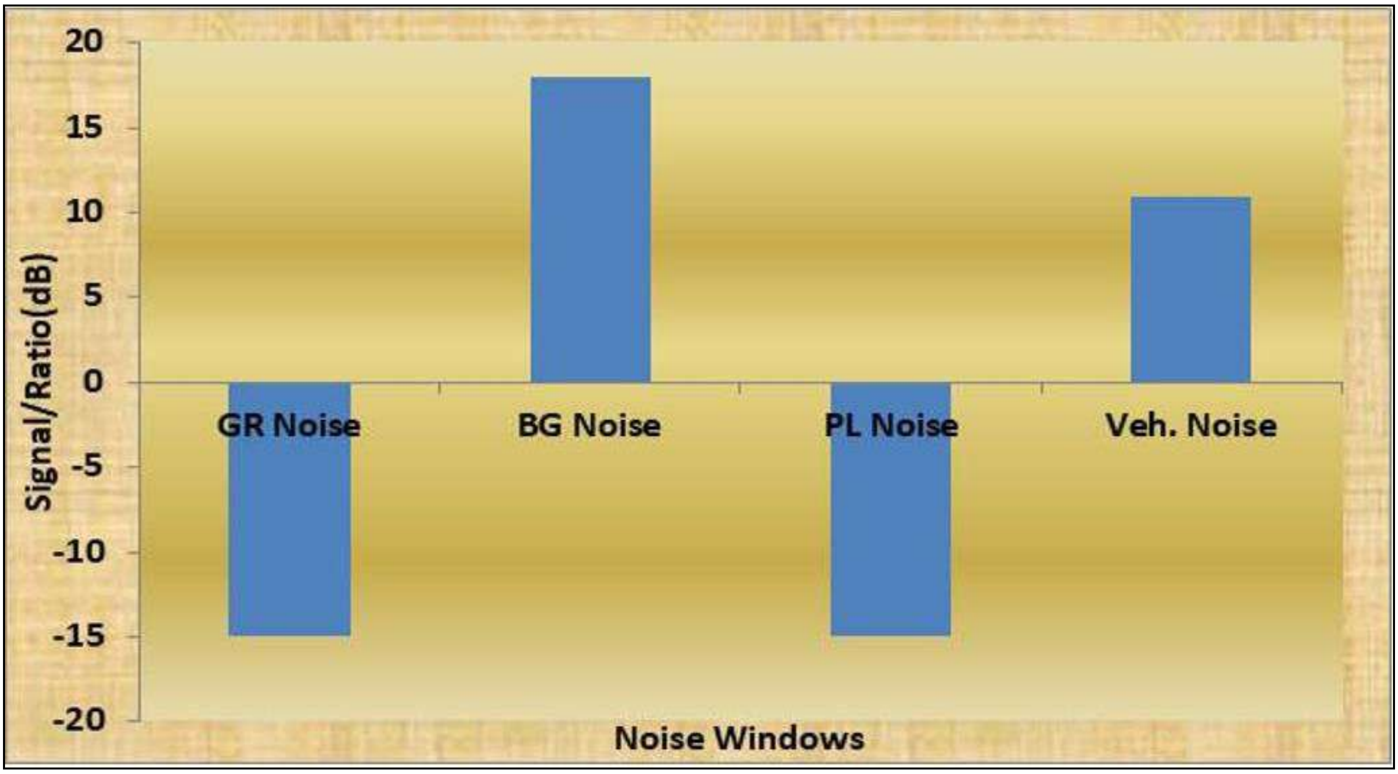


Fig 36 Behavior of the Various Noise Energies to the Signal Energy for 2D the Records

Based on the analysis, we can state that Ground roll noise and power line noise has much more energy (approximately 30-40 dB over the signal). The background and Vehicular noise is low energy noises. For this reason it is essential to filter ground roll and power line noises effectively.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

CHAPTER FOUR
EFFECT OF DIFFERENT SOURCE PARAMETERS; (SWEEP FREQUENCY, SWEEP LENGTH, SWEEP NUMBER) TO THE SIGNAL TO NOISE RATIO FOR 2D VIBROSEIS RECORD

The energy of a seismic wave is proportional to the square of the amplitude. Therefore the seismic energy in a given window will be proportional to

Energy = $\frac{\sum A^2}{n}$ where"n" is the number of sample and $"A"$ is amplitude.

To be able make this analysis for both 2D and 3D vibrosite record I created a window for ground roll noise which is the critical noise and a window for the signal. I ran an amplitude spectrum analysis on the raw without any form noise attenuation on each window, and then generate amplitude value which I used in computing the energy for each record by using the energy formulae. Then compare the noise energy to that of the signal. Signal to noise level on dB scale is calculated:

$$S/N = 10 \text{ Log}_{10} \frac{Signal\ energy}{Noise\ energy}$$

Table 6 Shows Calculated 2D full Vibroseis Records Energy, Signal Energy, Critical and Ambient Noise Energy of Each Record, and its S/N Ratio Without Noise Attenuation

2D VIBROSIES RECORDS	Full Record Energy	Signal Energy	Ground Roll Noise Energy	Ambiant Noise	S/Ambiant Noise Ratio (dB)	S/Ground roll Noise Ratio
6-110 Hz 3vib1Sweep	2.4E+29	8.6E+25	1.4E+28	1.3E+6	198	-22
6-110 Hz 3vib2weep	5.8E+30	2.7E+27	3.6E+29	1.3E+6	213	-21
6-110 Hz 3vib4weep	9.1E+31	3.1E+28	4.9E+30	1.3E+6	224	-22
6-110Hz (12 sec Sweep)	1.3E+29	3.9E+25	1.6E+28	1.3E+6	195	-26
6-110Hz (16 sec Sweep)	2.4E+29	9.3E+25	1.4E+28	1.3E+6	199	-22
6-110Hz (20 sec Sweep)	6.6E+29	1.2E+26	1.8E+28	1.3E+6	200	-22
6-96Hz	4.6E+29	2.1E+26	2.3E+28	1.3E+6	202	-20
6-110Hz	3.5E+29	1.4E+26	1.9E+28	1.3E+6	200	-21
6-120Hz	3.0E+29	1.2E+26	1.8E+28	1.3E+6	200	-22
8-96Hz	4.8E+29	1.9E+26	2.9E+28	1.3E+6	202	-22
8-110Hz	3.6E+29	1.3E+26	1.8E+28	1.3E+6	200	-21
8-120Hz	3.1E+29	1.2E+26	1.8E+28	1.3E+6	200	-22

Table 7 Shows Calculated 2D full Vibroseis Records Energy, Signal Energy, Critical and Ambient Noise Energy of Each Record, and its S/N Ratio After Noise Attenuation

2D Vibrosies Records	Full Record Energy	Signal Energy	Ground Roll Noise Energy	Ambiant Noise	S/Ambiant Noiseratio (Db)	S/Ground Roll Noise Ratio
6-110Hz 3vib1sweep	4.7E+24	4.6E+23	5.1E+24	8.6E+5	187	-10
6-110Hz 3vib2sweep	2.1E+28	2.6E+27	1.4E+28	8.6E+5	215	-7
6-110Hz 3vib4sweep	2.1E+28	2.9E+27	1.3E+28	8.6E+5	215	-6
6-110Hz (12 sec Sweep)	2.8E+24	3.8E+23	1.4E+24	8.6E+5	176	-6
6-110Hz (16 sec Sweep)	5.0E+24	6.8E+23	2.7E+24	8.6E+5	179	-6
6-110Hz (20 sec Sweep)	6.7E+24	9.1E+23	3.5E+24	8.6E+5	180	-6
6-96Hz	7.7E+24	1.8E+24	1.2E+25	8.6E+5	183	-8
6-110Hz	7.6E+24	1.4E+24	4.6E+24	8.6E+5	182	-5
6-120Hz	7.3E+24	1.1E+24	5.0E+24	8.6E+5	181	-7
8-96Hz	7.3E+24	1.3E+24	4.9E+24	8.6E+5	182	-6
8-110Hz	6.9E+24	1.2E+24	4.4E+24	8.6E+5	181	-6
8-120Hz	5.8E+24	8.3E+23	3.7E+24	8.6E+5	180	-6

Table 6 above shows the energy values of the full 2D record which comprises both the signal, and the energy of the windows and their signal to noise ratio without noise attenuation, Table 7 shows the signal to noise ratio and energy of the windows after noise attenuation. From Table 7 we can state that there is a mass improvement of signal to noise ratio of about 75% of the raw data after deconvoluion of each data and F-K filtering of the critical noise (ground roll).

- *Effect of Different Source Parameters; (Sweep Frequency, Sweep Length, Sweep Number, Vibrator Number) to the Signal to Noise Ratio for 3D Vibroseis Records*

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Energy = $\frac{\sum A^2}{n}$ where"n" is the number of sample and "A" is amplitude.

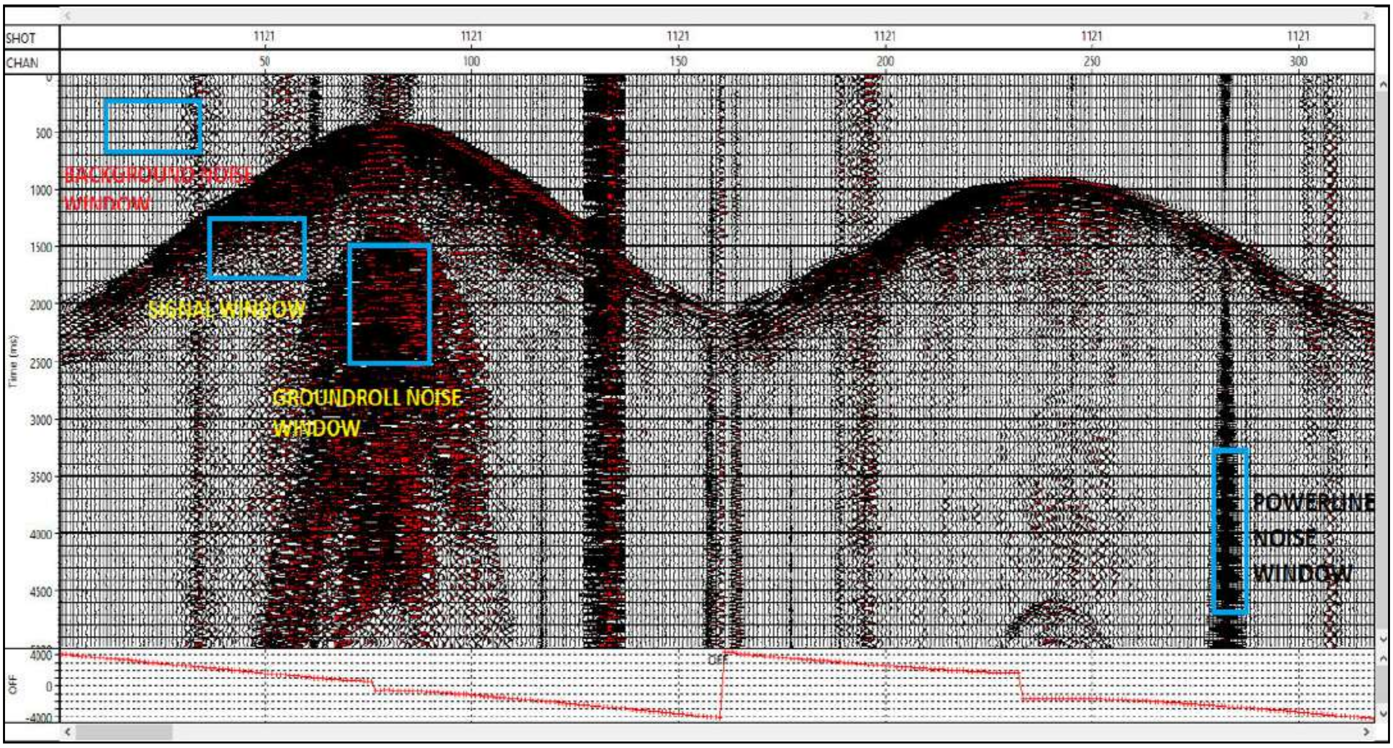


Fig 37 Displaying the Noise and Signal Windows for 3D Seismic Record

Seismic Windows	Average Energy	S/N Ratio Linear scale	S/N Ratio dB scaled
Signal	5.0E-02	N/A	N/A
Ground Roll Noise	1.6E+01	0.003	-25
Back Ground Noise	4.0E-02	1.25	1.0
Power Line Noise	4.0E-02	1.25	1.0

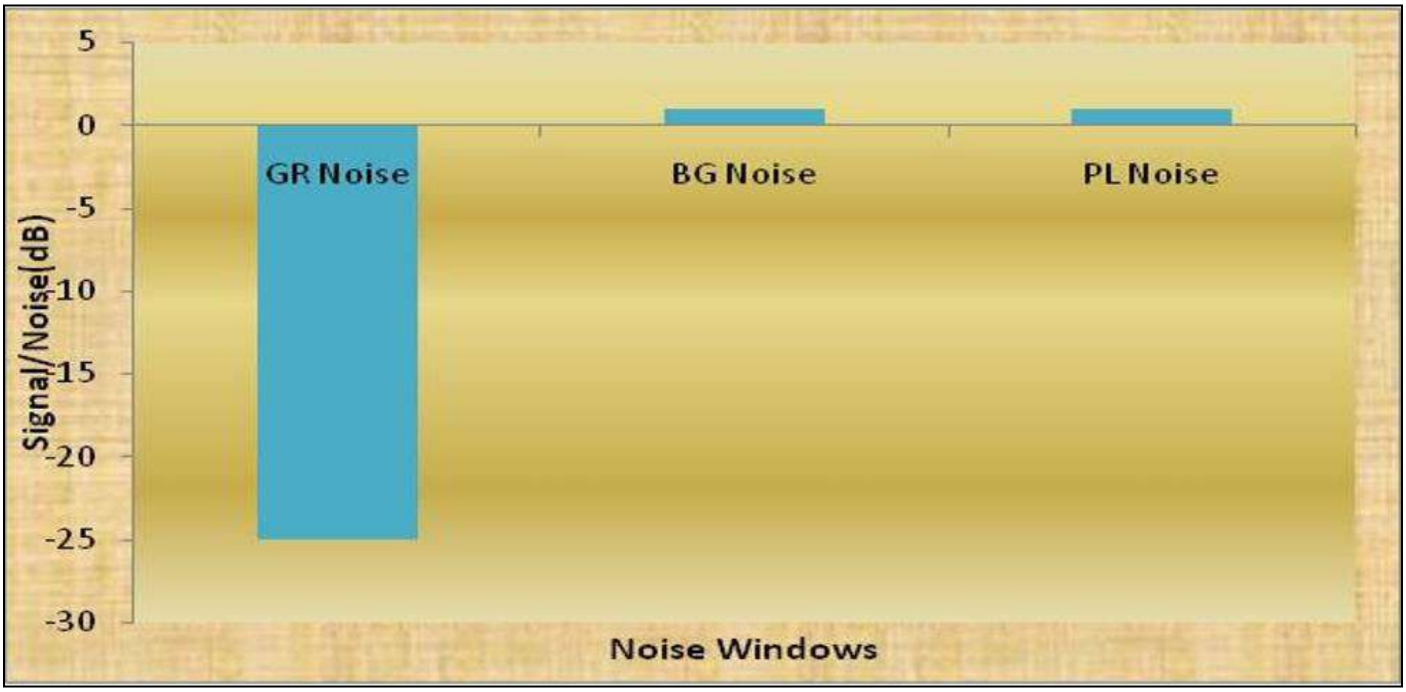


Fig 38 Behavior of the Various Noise Energies to the Signal Energy for 3D the Records

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Table 8 Shows Calculated 3D Full Record Energy, Signal Energy, Noise Energy of Each Record, and its S/N Ratio Before Noise Attenuation.

3D VIBROSIES RECORDS	Full Record Energy	Signal Energy	Ground Roll Noise Energy	Ambient Noise	S/Ambient NoiseRatio (dB)	S/Ground roll Noise Ratio
6-110Hz 14sec 2vb2sweep	3.2E-01	5.6E-03	11.94.319075348	4.0E-02	-9	-33
6-110Hz 16sec 2vb2sweep	3.0E-01	5.8E-03	11.7	4.0E-02	-8	-23
6-110Hz 18sec 2vb2 sweep	3.3E-01	6.0E-03	11.5	4.0E-02	-8	-23
6-110Hz 20sec 2vb2sweep	3.2E-01	6.0E-03	12.7	4.0E-02	-8	-33
6-110Hz 18sec 1vb2sweep	2.6E-01	3.7E-03	20.9	4.0E-02	-10	-37
6-110Hz 18sec 1vb4sweep	2.6E-01	2.4E-03	23.5	4.0E-02	-12	-40
6-110Hz 18sec 1vb6sweep	2.3E-01	2.2E-03	25.3	4.0E-02	-13	-41
6-110Hz 18sec 2vb1sweep	4.0E-01	5.6E-03	12.5	4.0E-02	-9	-33
6-110Hz 18sec 2vb2 sweep	3.3E-01	6.0E-03	11.5	4.0E-02	-8	-33
6-110Hz 18sec 2vb4 sweep	3.5E-01	5.7E-03	11.8	4.0E-02	-8	-33
6-80Hz	7.66	1.2E-02	23.8	4.0E-02	-5	-33
6-96Hz	4.3E-01	7.8E-03	14.3	4.0E-02	-7	-33
8-80 Hz 2vb2sweep	3.1E-01	5.5E-03	10.0	4.0E-02	-9	-33
8-96 Hz 2vb2sweep	2.20	7.7E-03	10.1	4.0E-02	-7	-31
8-110 Hz 2vb2sweep	4.2E-01	5.6E-03	9.5	4.0E-02	-9	-32

Table 9 Shows Calculated 3D full Record Energy, Signal Energy, Noise Energy of Each Record, and its S/N Ratios

3D VIBROSIES RECORDS	Full Record Energy	Signal Energy	Ground Roll Noise Energy	Ambient Noise	S/Ambient NoiseRatio (dB)	S/Ground roll Noise Ratio
6-110Hz 14sec 2vb2sweep	1.5E-03	8.3E-05	2.5E-2	4.3	-47	-25
6-110Hz 16sec 2vb2sweep	4.4E-03	3.3E-04	1.1E-01	4.3	-41	-25
6-110Hz 18sec 2vb2sweep	3.1E-02	6.1E-04	8.9E-02	4.3	-38	-22
6-110Hz 20sec 2vb2sweep	6.5E-03	3.1E-04	1.2E-01	4.3	-41	-25
6-110Hz 18sec 1vb2sweep	2.4E-03	7.0E-05	2.4E-02	4.3	-47	-25
6-110Hz 18sec 1vb4sweep	1.4E-03	1.5E-04	9.8E-02	4.3	-45	-28
6-110Hz 18sec 1vb6sweep	2.6E-03	1.0E-04	9.6E-02	4.3	-46	-30
6-110Hz 18sec 2vb1sweep	1.0E-02	3.1E-04	1.2E-02	4.3	-41	-26
6-110Hz 18sec 2vb2sweep	5.0E-03	4.1E-04	8.9E-02	4.3	-40	-23
6-110Hz 18sec 2vb4sweep	6.6E-03	3.7E-04	9.4E-02	4.3	-41	-24
6-80Hz	4.E-02	5.5E-04	1.8E-01	4.3	-39	-25
6-96Hz	2.1E-02	2.7E-04	1.3E-01	4.3	-42	-27
8-80 Hz 2vb2sweep	1.2E-02	7.5E-04	1.7E-01	4.3	-38	-23
8-96 Hz 2vb2sweep	3.1E-02	6.1E-04	8.9E-02	4.3	-38	-22
8-110 Hz 2vb2sweep	4.8E-03	4.4E-04	8.0E-02	4.3	40	-23

Table 8 above shows the energy values of the full 3D record which comprises both for the (signal and noise) energy of the windows and their signal to noise ratio without noise attenuation, Table 9 shows the signal to noise ratio and energy of the windows after noise attenuation. From Table 9 we state that there about 20% signals to noise ratio improvement of the raw data after deconvoluion of each data and removal of the critical noise (ground roll).

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

CHAPTER FIVE
EFFECT OF DIFFERENT SOURCE PARAMETERS; (CHARGE DEPTH, CHARGE WEIGHT, NUMBER OF HOLES) TO THE SIGNAL TO NOISE RATIO FOR 3D VIBROSITE RECORDS

- *Charge Depth*

This is the depth in meters at which the explosive was detonated; it ranges from 3-100 meters. It sometimes affected by terrain, a strong rugged, and rocky train makes it difficult to get to actual need depth in some cases.

- *Charge Weight*

The weight of the charge which is measured in kilogram is proportional to 3rd power of the energy or the power of the explosive used to generate the source. The higher the weight the higher the amount of energy or seismic wave it can generate. In some cases tamping can affect the explosive power, ensuring a good tamping and contact of the explosive to the ground will enhance the energy transfer to the earth.

- *Charge Hole*

This is the number of holes at a particular source points. In some special cases the explosive charge can be divided into smaller charges and place in the different holes for instance; 1,2 or3 as the case may be, in a rugged very hard terrain where drilling a deep hole is giving difficulty a shallow holes can be drill instead. Higher number of holes has proven to yield better result than a single hole.

Energy = $\frac{\sum A^2}{n}$ where "n" is the number of sample and $"A"$ is amplitude.

10 Log of the energy ratios will convert S/N into decibel (dB) scale. To analyze these effects an amplitude spectrum was run on a seismic window which I created for the critical noise and signal and also on the full seismic record (noises and signal) and amplitude values was gotten and by using the Energy formulae above I calculated the noise energy and signal energy and got a ratio of both.

Table 10 Shows Calculated 2D Full Explosive Records Energy, Signal Energy, Noise Energy of Each Record, and its S/N Ratio Without Noise Attenuation.

2D Explosives Records	Full Record Energy	Signal Enercy	Noise Energy	S/N Ratio Linear Scale	S/N Ratio DB Scale
3m*3m*3m 0.5kg	4.1E+11	3.7E+08	1.6E+11	2.3E-03	-26
3m 1kg	3.2E+11	5.7E+07	6.3E+10	9.0E-04	-30
5m 1kg	2.2E+11	5.5E+07	4.2E+10	1.3E-03	-29
7m 1kg	1.7E+11	1.1E+08	1.9E+10	5.4E-03	-23
5m 2kg	4.1E+11	8.7E+07	2.5E+11	3.4E-03	-25
7m 2kg	4.8E+11	2.7E+08	1.6E+11	1.8E-03	-27

Table 11 Shows Calculated 2D Full Explosive Records Energy, Signal Energy, Noise Energy of Each Record, and its S/N Ratio After Noise Attenuation

2D Explosives Records	Full Record Energy	Signal Energy	Noise Energy	S/N Ratio Linear Scale	S/N Ratio DB Scale
3m*3m*3m 0.5kg	5.6E10	3.2E+08	8.3E+09	3.8E-02	-14
3m 1kg	5.6E+10	6.5E+07	6.7E+09	9.8E-03	-20
5m1kg	5.4E+10	5.4E+07	4.4E+09	1.2E-02	-19
7m1kg	4.1E+11	1.0E+08	3.2E+09	3.2E-02	-15
5m2kg	5.1E+10	1.1E+08	1.1E+09	1.1E-01	-9
7m2kg	5.8E+10	3.1E+08	3.3E+09	9.8E-2	-10

Table 10 above shows the energy values of the full 2D record which comprises both the (signal and noise) the energy of the windows and their signal to noise ratio without noise attenuation, Table 11 shows the signal to noise ratio and energy of the windows after noise attenuation. From Table 11 we state that there about 50% signals to noise ratio improvement of the raw data after deconvolution of each data and removal of the critical noise (ground roll).

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

CHAPTER SIX
PROCESSING FLOWS FOR NOISE ATTENUATION AND SIGNAL TO NOISE RATIO ATTENUATION

For the fact that we do not record only signals but also record many other interactions, different seismic noises. It is necessary to amplify the signal by and attenuating the critical noise which reduces the resolution and gives a bad image of seismic record. Consequently, I develop some seismic flows which I used to remove the critical noise before carrying out the comparison of the analysis of different parameters. The two data set passes through different processing steps e.g. (muting, band filtering, deconvolution, F-k Filtering) until the noise is eliminated and a seismic was improve. Unfortunately, it is never possible to eliminate the every noise with these processing flows because this work is not aim to get the final processing step of post migration.

➢ *Noise Attenuation Chart Flow*

- Reading Field Data
- Assigning Geometry
- Frequency Analysis
- Mute and kill Determination
- Band Pass filter
- F-K spectrum Analysis
- Deconvolution
- Signal/Noise 2D analysis

➢ *Reading the Data*

This is the process in which the data which was in SEG-D DEMUX format was transferred into SEG-Y demultiplexed data formats. First step is the downloading the data then visualize the seismic record on the screen. With help of the some interactive facilities of the VISTA software further processing steps on the data for example filtering, deconvolution, amplitude spectra analyses and F-K spectra analysis can be done.

➢ *Mute*

The process by which we remove the direct waves and reflections which are unrelated with the primary reflection to improve the data quality is tagged muting. The data does not always contain the reflected data. It may also contain first arrivals, supper critical reflections, ground roll etc. Muting can be applied in four different kinds.

- Top Mute
- Bottom Mute
- Surgical Mute.
- NMO-stretch Mute

➢ *Band Pass Filter*

The aim of band pass frequency filtering is to remove unwanted frequency components from the seismic record. Band pass filter is mainly used for many noises in the signal frequency band or weak signal to be filtered out. They are applied before NMO and most commonly applied to a post migration processing flow to improve the clarity of the display.

Raw seismic data contains amplitude in almost all the frequency components between zero and f_N.This amplitude corresponds to reflection signals and noise components. The amplitude of the signal is usually limited by the frequency band which produces from seismic source. For example; if the seismic source is effectively producing the signal range of 10-140 Hz, the sampling time is 1ms and f_N =500Hz, then it means that in the part of the 140-500Hz range consist of only high noise. The band pass filter is the commonest used. A notch filter might be used to suppress a single frequency for example that of power line adjacent to a land survey.

- Band pass filter
- Notch Filter

➢ *Deconvolution*

Convolution is the process by which a wavelet combines with a series event to produce the seismogram that is recorded in seismic survey.

Deconvolution usually involves convolution with an inverse filter. It is a process universally applied to seismic data to increase resolution; attempts to compress the wavelet yield a more interpret-able section. Deconvolution eliminates correlation

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

reflections, multiples and compresses the seismic wavelets and I ideally leaving only the earth's reflectivity in the seismic trace. Another goal of deconvolution is to produce a wavelet with a simple phase character, ideally a zero phase wavelet, which is the same at every trace in the seismic data set. Deconvolution is of many types.

- Deterministic Deconvolution
- Predictive Deconvolution
- Statistical Deconvolution

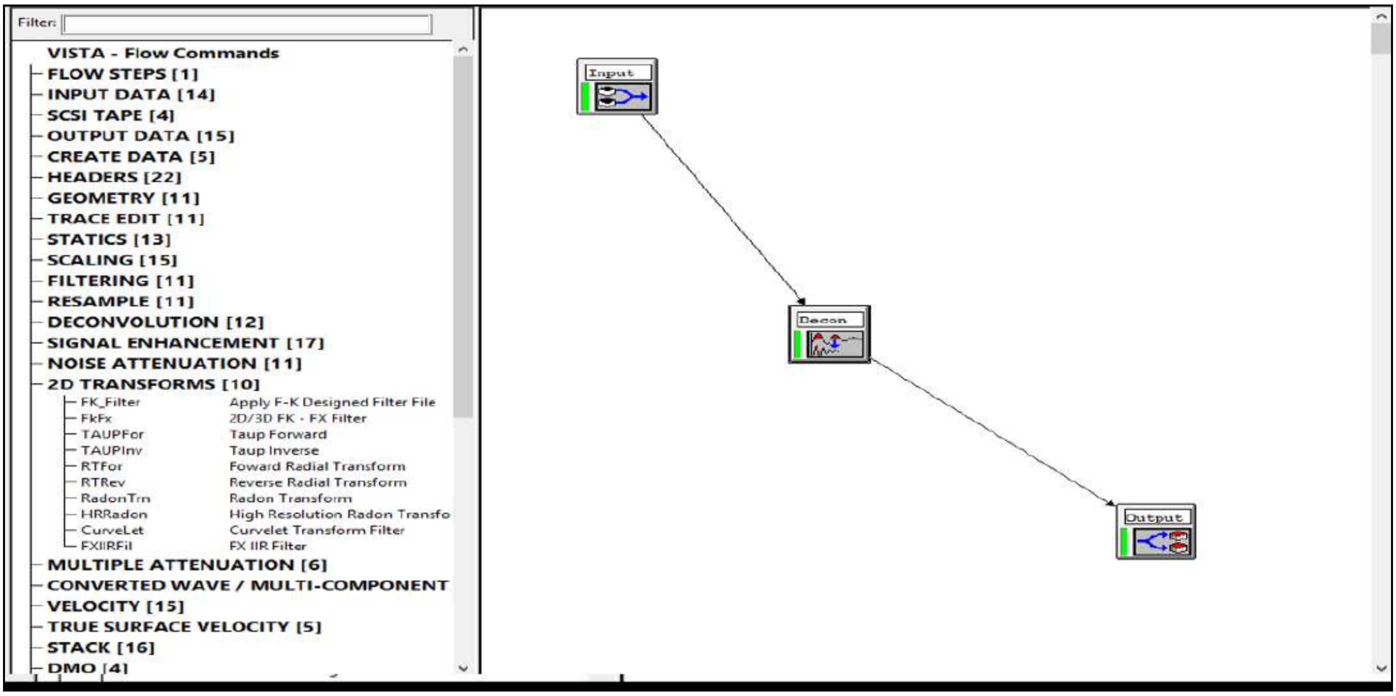


Fig 39 Deconvolution Processing Flow Design for the Seismic Processing and to Improve the S/N Ratio

- *F-K Spectral Analysis*

A two Dimensional Fourier transform over time and space is called an F-K transform where F is the frequency and the k is the wave number. For land seismic records, there are several noise types such ground roll, which is a low frequency or seismic interference may be readily suppress in the F-K frequency domain than in the time space domain and therefore will be easier to mute before the inverse transform is applied.F-K filter usually eliminates the pure S wave. But it is not good to eliminate other converted waves with high velocity. To design an F-K Spectrum, regions are chosen where amplitude will pass by eliminating, attenuating the noises as can be seen in Fig.41. In some cases F-K filter can generate some artificial noises and that case we do not apply an F-K filter but is working properly in my case.

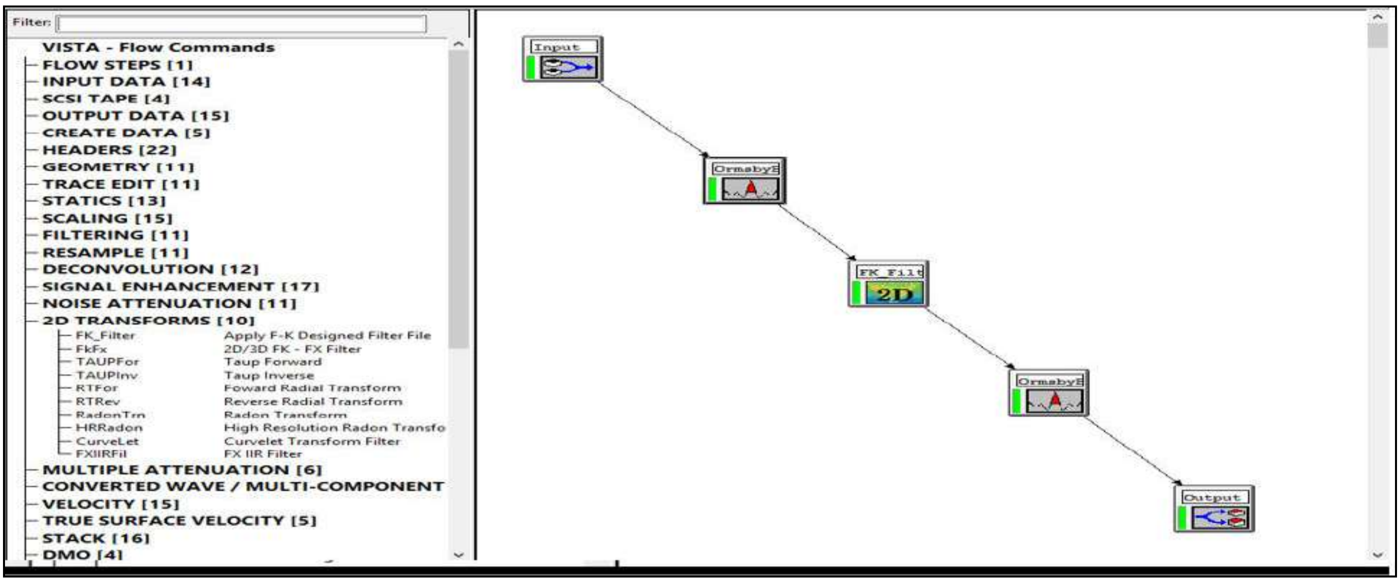


Fig 40 F-K Filter Processing Flow Design for the Removal of the Critical Noise to Enhance the S/N Ratio.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

CHAPTER SEVEN
RESULT ANALYSIS AND DISCUSSION

➢ *Signal to Noise Ratio 2D Analyses*

Using an interactive Window section of vista I was able to compare a 2D explosive (3m1kg), a 2D vibrosite record (6-110Hz) and 3D Vibrosite record (8-110Hz) just to show the signal to noise ratio of the record data before the removal of the critical (ground roll) and after the removal of the ground roll noise. The picture shows an enhancement on the signal to noise by the applying F-k filtering processing step on the 3 data set. As shown in the figs. 41-42 below.

➢ *2D Explosive Record*

We can see from Fig. 41b below the effect of applying f-k spectrum filter on 41a to suppress the ground roll noise. Though the noise is not eliminated completed but we can observe a massive enhancement of the signal and suppression of noise. The reflections become more visible and the ground roll noise suppress**.**

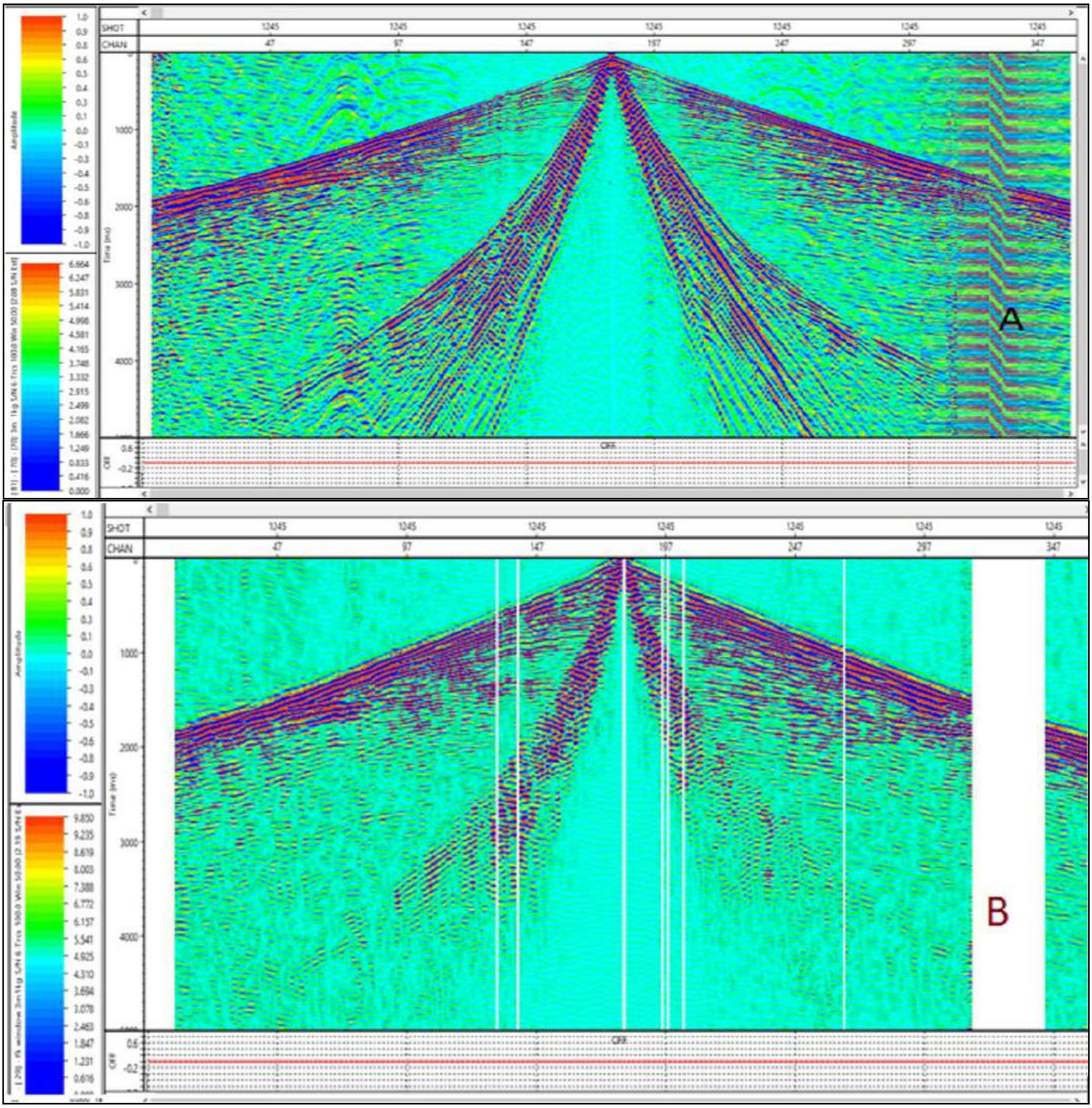


Fig 41 Signal to Noise Ratio Comparison Analysis for 2D 3m1kg Explosive Record A Before and B After Noise Attenuation.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

➢ *2D Vibroseis Record*

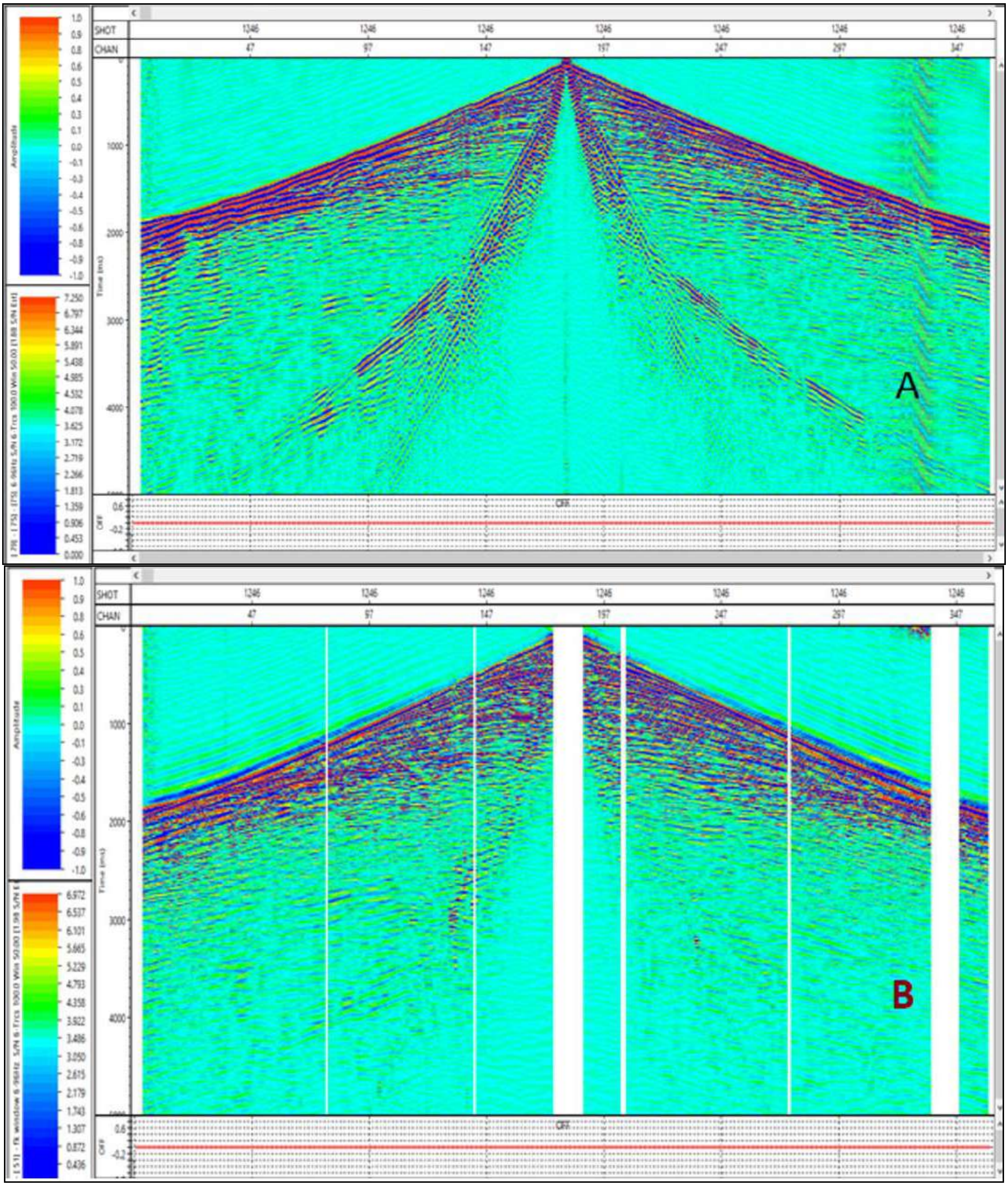


Fig 42 Signal to Noise Ratio Comparison Analysis for 2D 6-110Hz Vibroseis Record A Before and B After Noise Attenuation

Looking at Fig. 42 B and comparing with fig 42 A we can see the effect of applying F-K spectrum filter to suppress the ground roll noise. Though the noise is not eliminated completed but we can observe a massive enhancement of the signal and suppression of noise. The reflections become more visible and the ground roll noise suppress and the signal to noise ratio was massively increase as we see in the computation on tables below.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

➢ *Deconvolution of 3D Record*

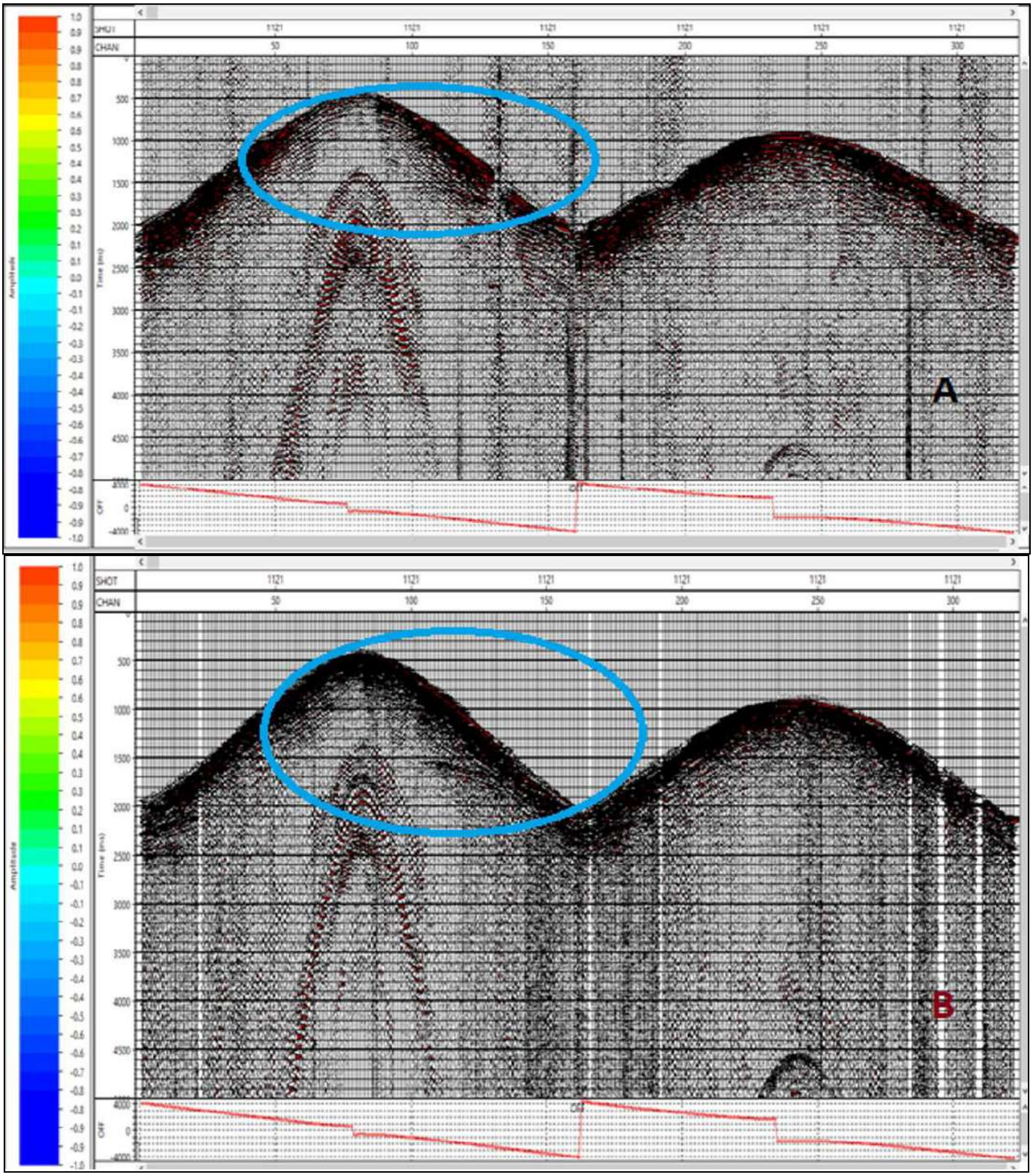


Fig 43 Shows a Comparison Deconvolved Pictures of 3D 6-96 Hz Vibroseis Record A Before Deconvolution and B After Deconvolution

We can observe from Fig. 43B when compared wit 43A that applying deconvolution processing step on the data set eliminates mostly the multiples and the noises which are above region of the first break. Consequently, by deconvolving the 3D data help massively to improve the signal to noise ratio. Initially, doing F-K filter analysis on the 3D data set without deconvolution there was no significant improvement on S/N ratio, but when I did the noise attenuation of the data set.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

➢ *3D Vibroseis Record*

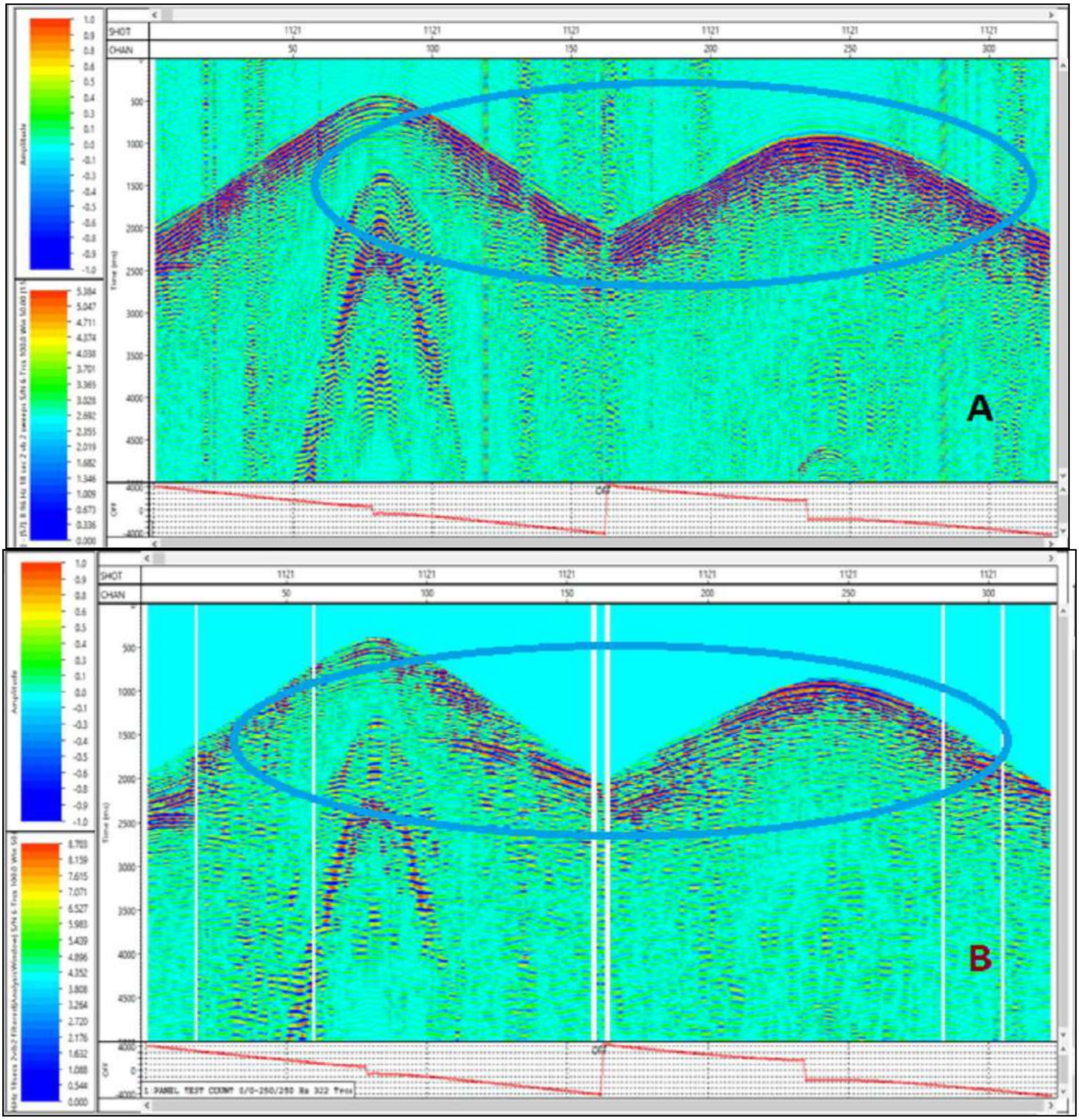


Fig 44 Signal to Noise Ratio Comparison Analysis for 3D 8-110Hz Vibroseis Record A Before and B After Noise Attenuation.

We can observe from Fig. 43B the effect of applying F-K spectrum filter to suppress the ground roll noise. Though the noise is not eliminated completed but we can observe a massive enhancement of the signal and suppression of noise. The reflections become more visible and the ground roll noise suppress and the signal to noise ratio was massively increase as we see in the computation on Table 6.

➢ *Comparison Analysis of Various Seismic Records with Respect to Noise Reduction Processing Procedure Results*

To be able to compare this seismic record parameters; (sweep frequency, sweep length, sweep number, vibrator number, signal strength and S/N ratio) for the vibrosies records and (charge weight, charge depth, number of shot holes) for the explosive on the signals to noise ratio. Consequently, haven known the critical noise from the noise analysis in Chapter 3 to be the ground roll noise and 50 Hz power line noise. I designed a two dimensional noise reduction flow for the attenuation and elimination of the

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

critical noises which was applied along with other noise reduction processing steps; (killing of the dead traces and very noise channels, muting out the background noise, deconvolving of the data to improve the S/N ratio, application of some band filtering etc. The comparison was possible by varying one parameter of each record while keeping constant the rest as shown in the table 2-5 above.

➢ *2D Explosive Parameter Comparison*

- *Charge Depth*

2D Explosive Record	S/Critical Noise ratio before Attenuation	S/Critical Noise after Attenuation
3m 1kg	-32	-20
5m 1kg	-29	-19
7m 1kg	-23	-15

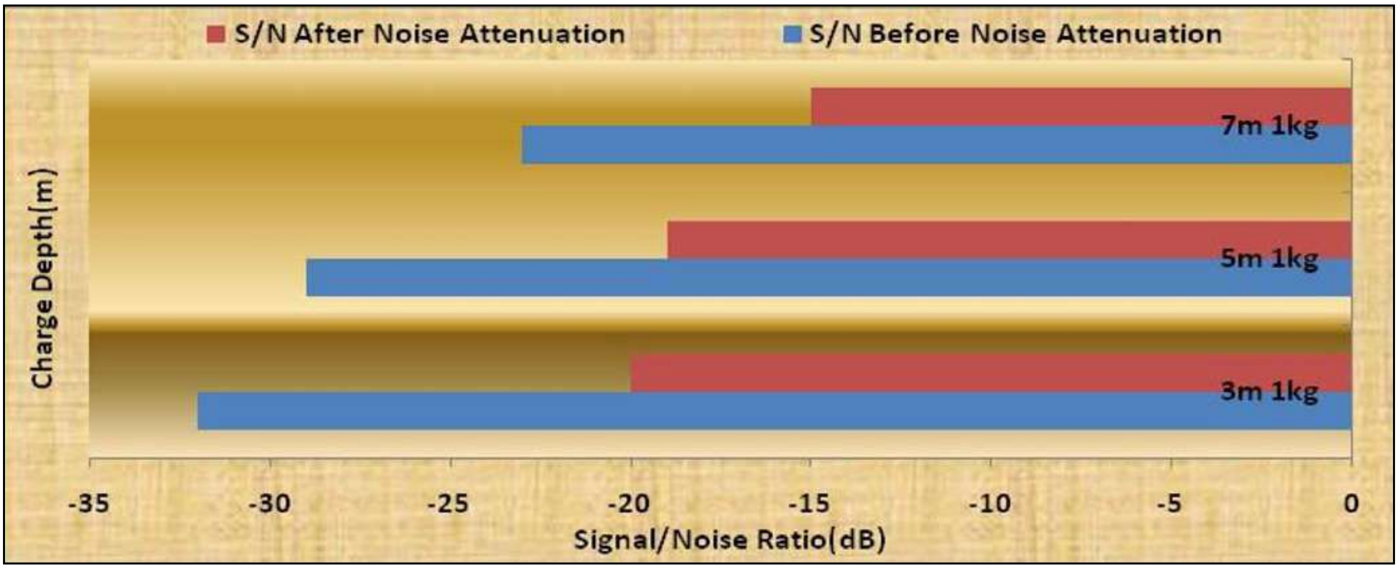


Fig 45 S/N Ratio Comparison Picture on Charge Depth for 2D Explosive Records Before and After Noise Attenuation.

Figure 45 shows the charge depth effect of different depth on the signal to noise ratio. We can see from the graphical representation that the signal increases as the depth increases.

2D Explosive Record	S/Critical Noise ratio before Attenuation	S/CriticalNoise after Attenuation
5m 2kg	-25	-9
7m 2kg	-27	-10

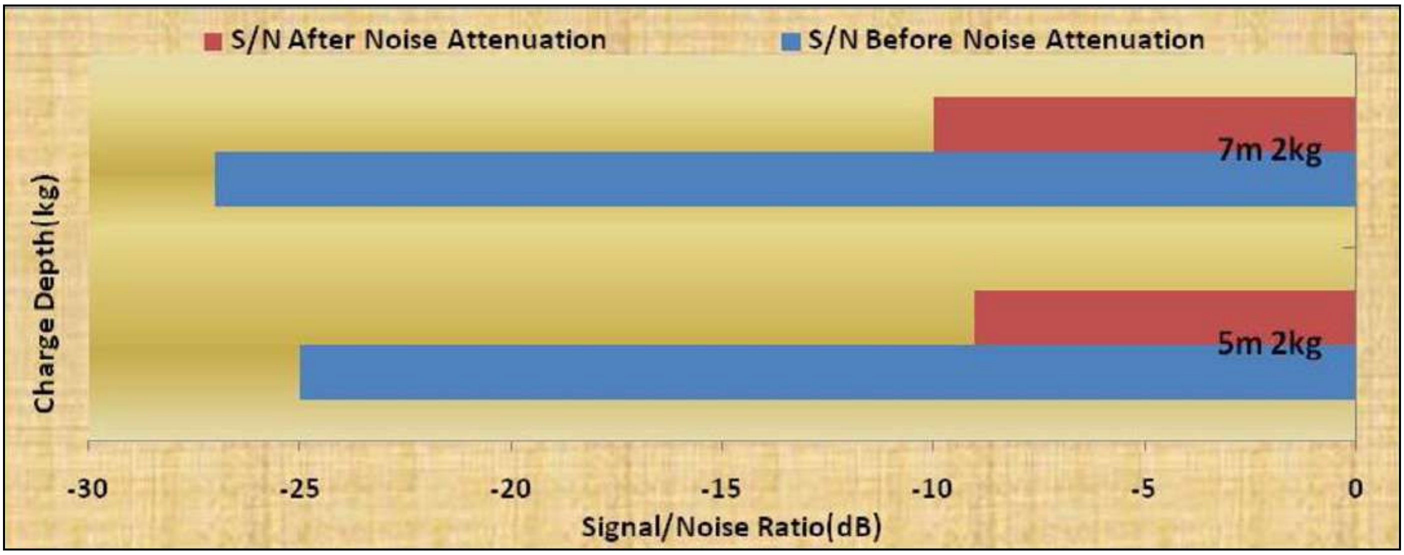


Fig 46 S/N Ratio Comparison Picture on Charge Depth for 2D Explosive Records Before and After Noise Attenuation

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

We can see on Fig. 46 that the noise is less in deeper depth but there is no change in signal after the noise attenuation.

- *Charge Weight*

2D Explosive Record	S/Critical Noise ratio before Attenuation	S/CriticalNoise after Attenuation
3*3*3m 0.5kg	-26	-14
3m 1kg	-30	-20

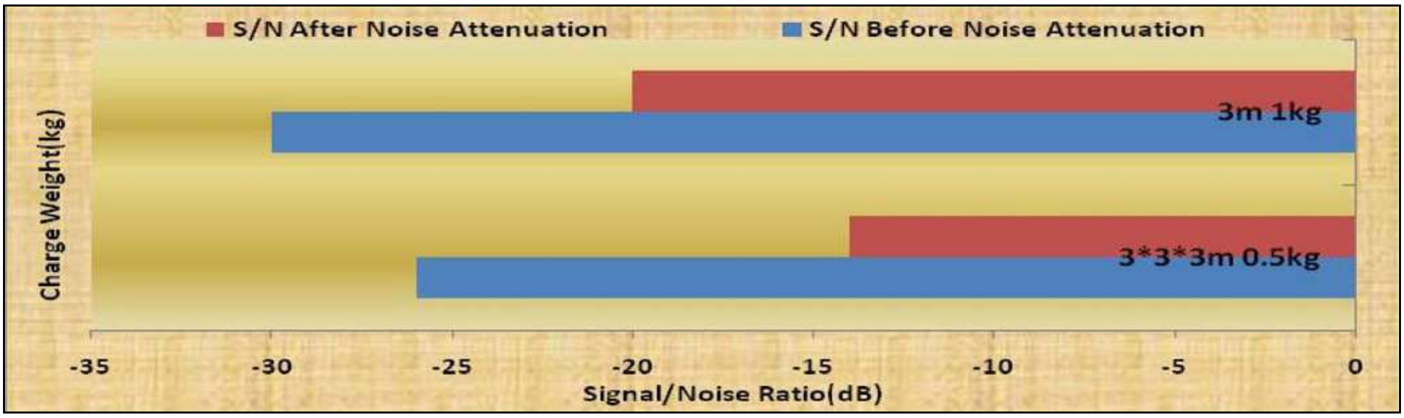


Fig 47 S/N Ratio Comparison Picture on Charge Weight for 2D Explosive Records Before and After Noise Attenuation.

2D Explosive Record	S/Critical Noise ratio before Attenuation	S/CriticalNoise after Attenuation
5m 1kg	-29	-19
5m 2kg	-25	-9

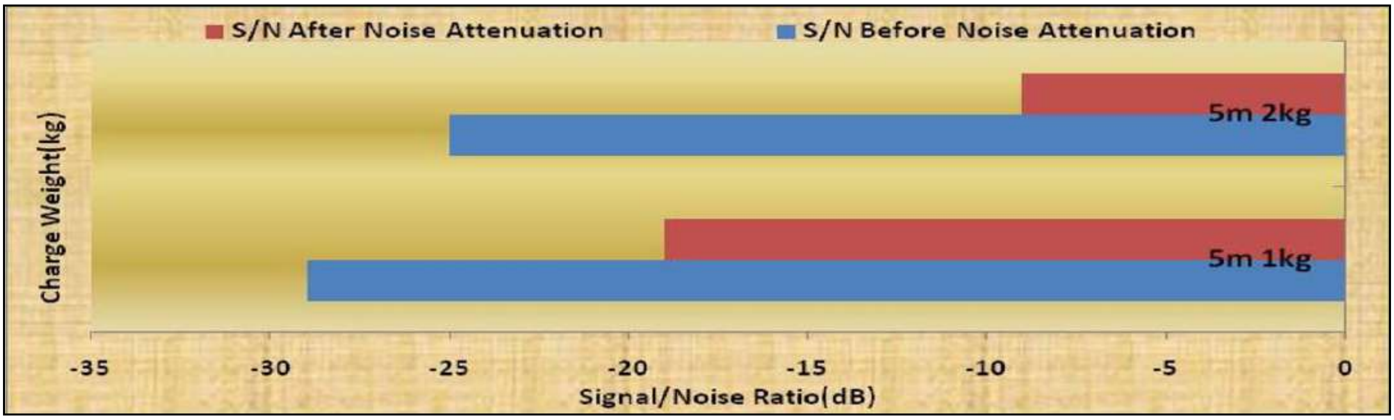


Fig 48 S/N Ratio Comparison Picture of Charge Weight for 2D Explosive Records Before and After Noise Attenuation

2D Explosive Record	S/Critical Noise ratio before Attenuation	S/Critical Noise after Attenuation
7m 1kg	-23	-15
7m 2kg	-27	-10

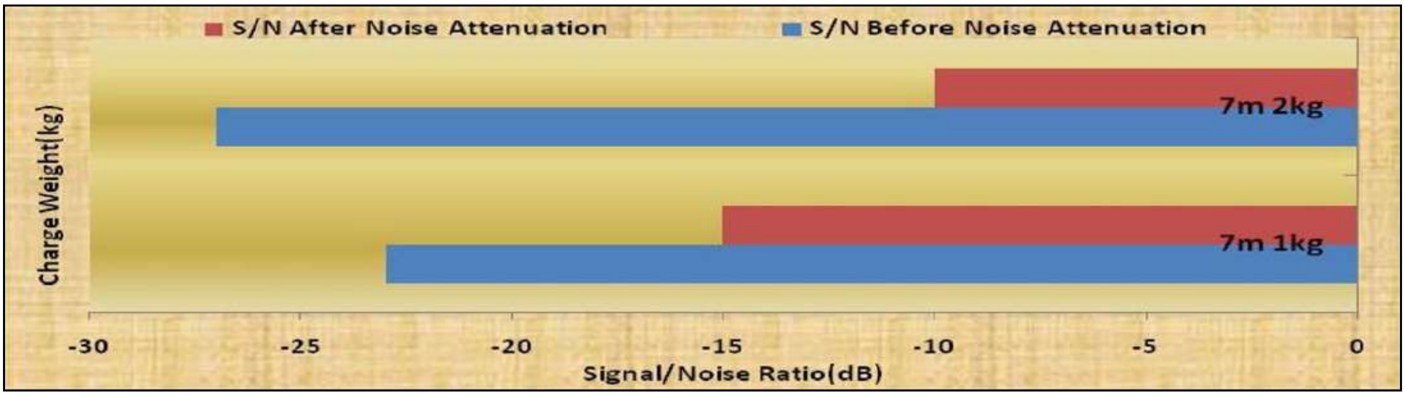


Fig 49 S/N Ratio Comparison Picture of Charge Weight for 2D Explosive Records Before and After Noise Attenuation

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

From the analyses we can state generally from the graphs that the noise increase with increasing charge weight but the signal is better after noise attenuation.

- *Number of Hole*

2D Explosive Record	S/Critical Noise ratio before Attenuation	S/Critical Noise after Attenuation
3*3*3m 0.5kg	-26	-14
3m 1kg	-30	-20
5m 1kg	-29	-19
7m 1kg	-23	-15

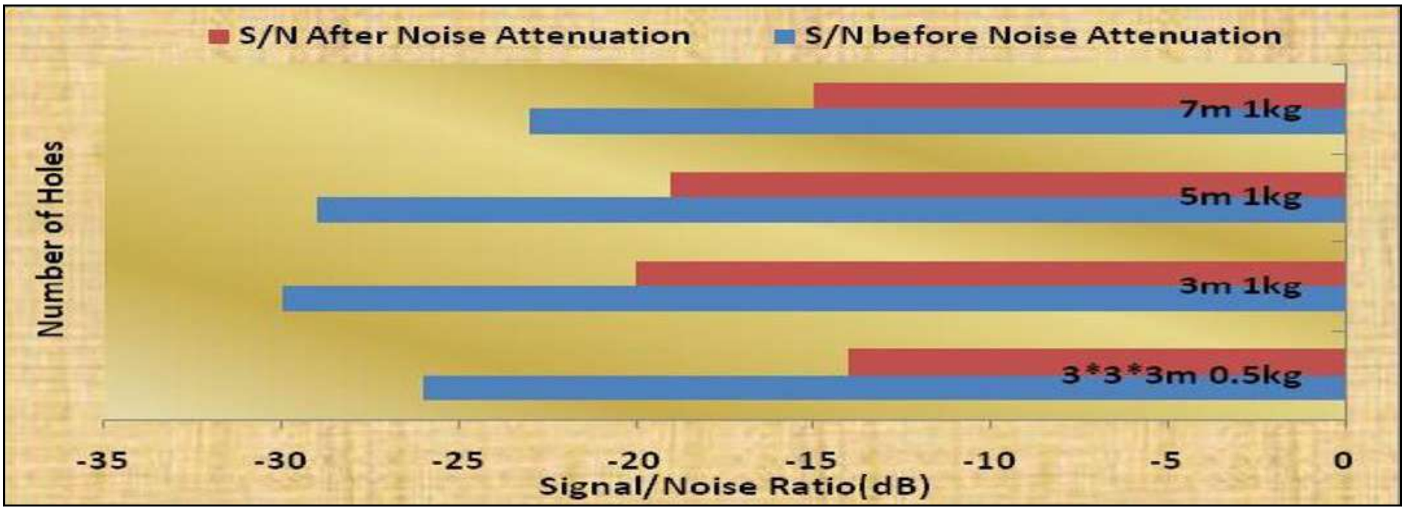


Fig 50 S/N Ratio Comparison Picture of Number of Holes for 2D Explosive Records Before and After Noise Attenuation

We can observe from Figure 50 that the signal to noise ratio is better in 3by3meter 0.5kg charge weight hole than in the other one hole with 1kg charge weight. The different in the signal can be as result of 0.5kg different in charge.

2D Explosive Record	S/Critical Noise ratio before Attenuation	S/Critical Noise after Attenuation
3*3*3m 0.5kg	-26	-14
5m 2kg	-25	-9
7m 2kg	-27	-10

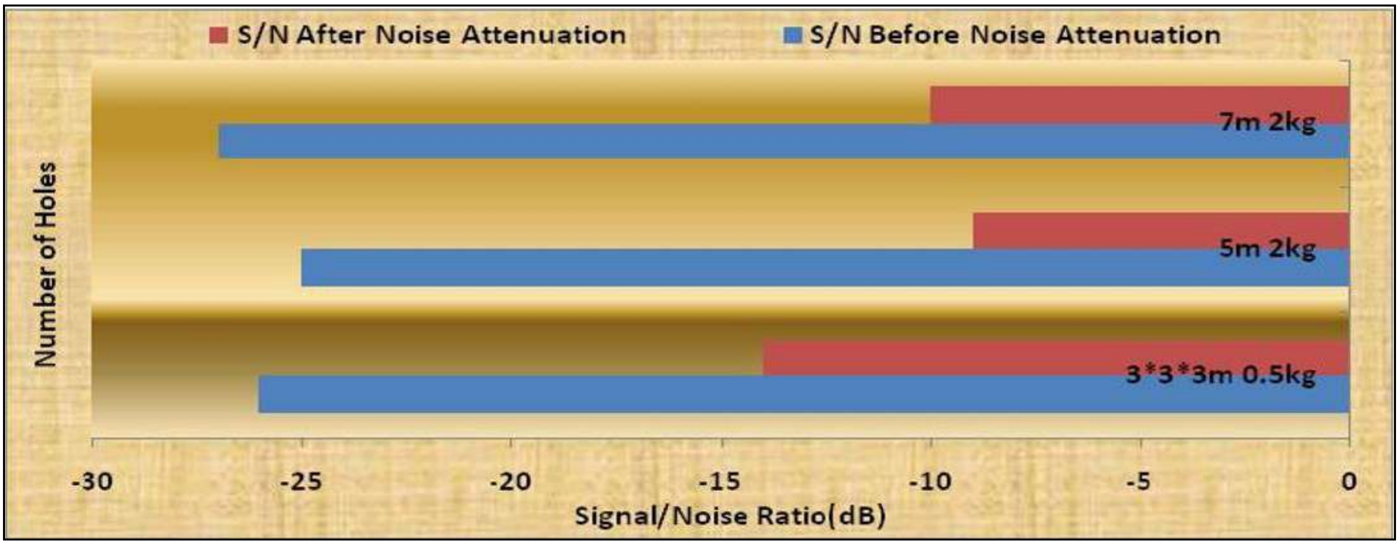


Fig 51 S/N Ratio Comparison Picture of Number of Holes for 2D Explosive Records Before and After Noise Attenuation

From Fig. 51 we can observe that the noise is lower in 3by3meter hole 0.5kg charge weight than in the other one hole with 2kg charge weight. But the signal to noise ratio is better in the later after noise attenuation. This can be due to 0.5 kg difference in the charge weight.

➢ *2D Vibroses Records Parameter Comparison*

* *Sweep Number*

Sweep Number	S/Critical Noise before Attenuation	S/Critical Noise after Attenuation	S/Ambiant Noise before Attenuation
6-110Hz 3vib1Sweep	-22	-10	198
6-110Hz 3vib 2Sweep	-21	-7	213
6-110Hz 3vib 4Sweep	-22	-6	224

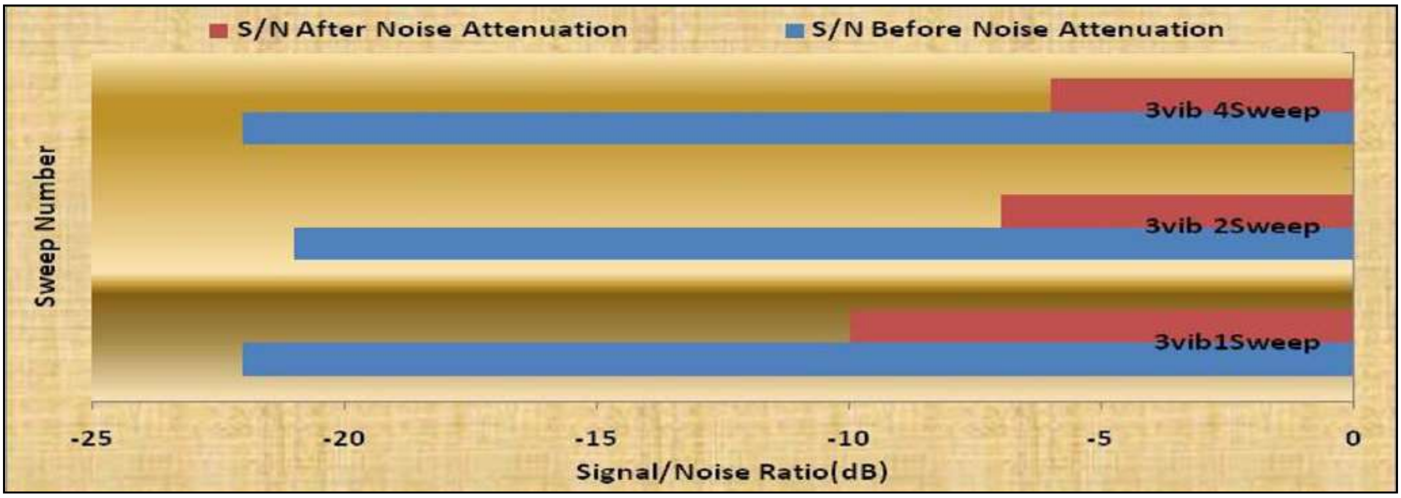


Fig 52 S/N Ratio Comparison Picture of Sweep Number for 2D Vibroseis Records Before and After Noise Attenuation

We can see from figure 52 that the signal to noise ratio increases with increase in sweep number, and the noise energy is approximately the same for the three recording different parameters.

* *Sweep Length*

Sweep Length	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambiant Noise before Attenuation
(12secs Sweep)	-26	-6	195
(16secs Sweep)	-22	-6	199
(20secs Sweep)	-22	-6	200

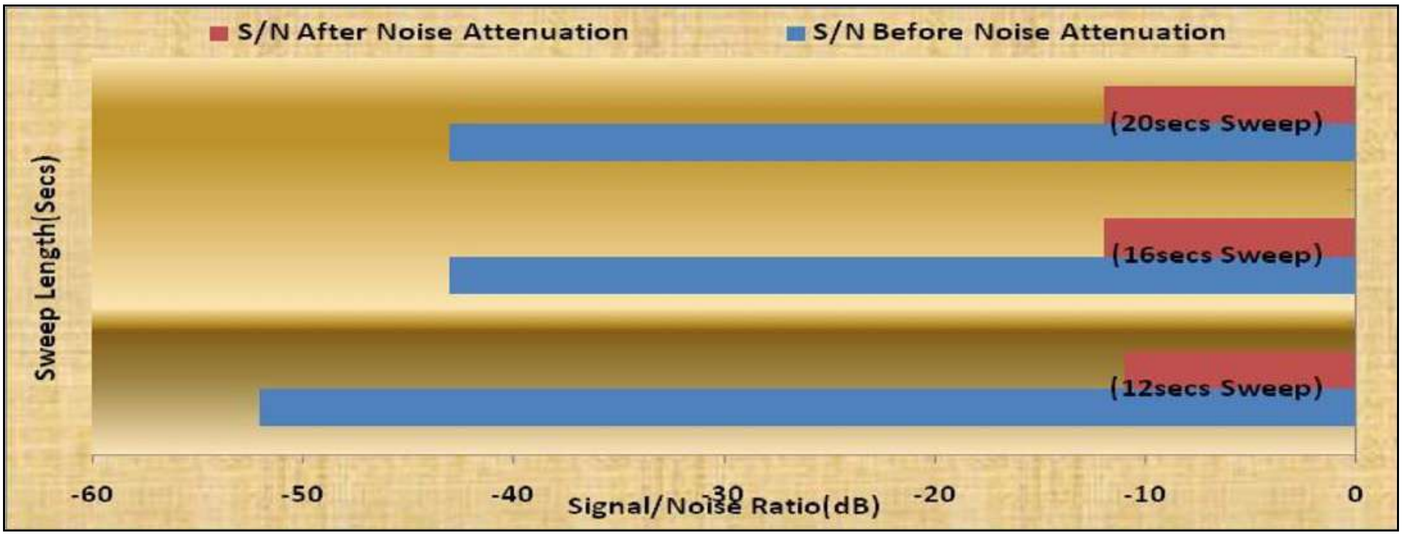


Fig 53 S/N Ratio Comparison Picture on Sweep Length for 2D Vibroseis Records Before and After Noise Attenuation.

We can see from Figure 53 that the signal to noise ratio increases with increase in sweep length, and the noise energy decreases with increase in the sweep number for the three recording different parameters.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

- *Frequency Band Width*

Band Width (Hz)	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambiant Noise before Attenuation
6-96Hz	-20	-8	202
6-110Hz	-21	-5	200
6-120Hz	-22	-7	200
8-96Hz	-22	-6	202
8-110Hz	-21	-6	200
8-120Hz	-22	-6	200

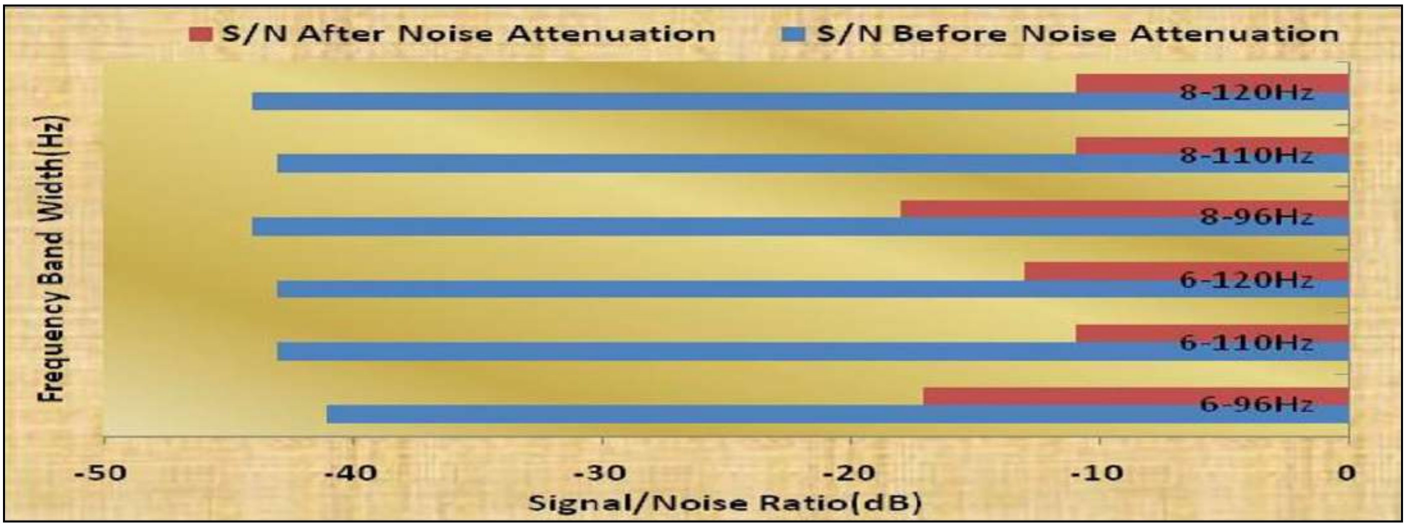


Fig 54 S/N Ratio Comparison Picture on Frequency Band Width for 2D Vibroseis Records Before and After Noise Attenuation.

We can observe from Figure 54 that the frequency band width between 6-110Hz and 8-110Hz shows the best signal to noise, therefore increasing the frequency beyond this range is not necessary, the noise energy is approximately the same for the whole frequency range.

> *3D Vibroseis Records Parameter Comparison*

- *Sweep Length*

Sweep Length (Secs)	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambiant Noise before Attenuation
14sec 2vb2sweep	-33	-25	-9
16sec 2vb2sweep	-23	-25	-8
18sec 2vb2 sweep	-23	-22	-8
20sec 2vb2sweep	-33	-25	-8

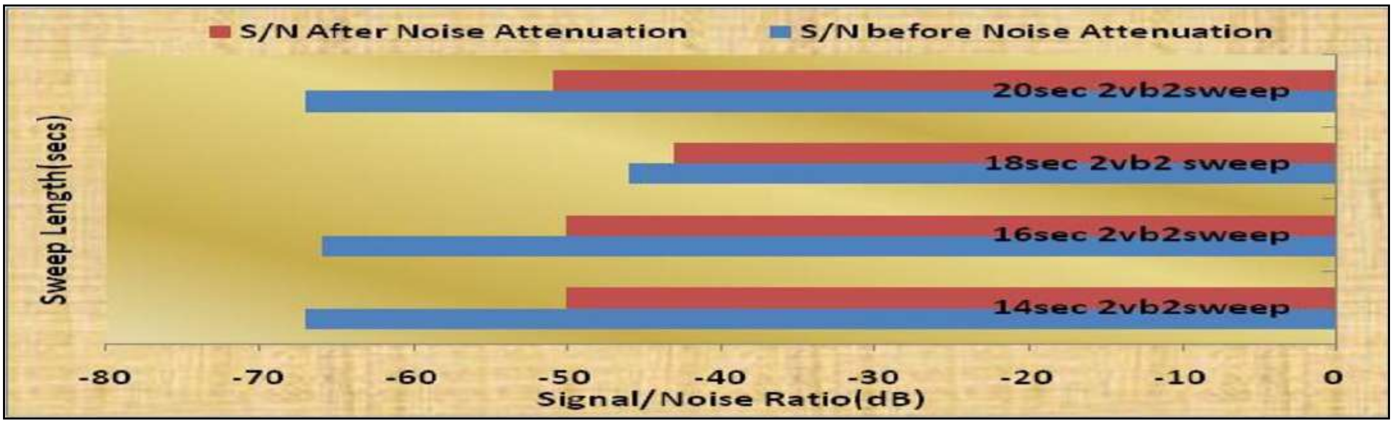


Fig 55 S/N Ratio Comparison on Sweep Length for 3D Vibroseis Records Before Noise Attenuation and After Noise Attenuation.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

We can see from Figure 54 that at 18 sec 2vib2 sweep record the signal to noise ratio. But increasing the sweep length did not have a significant effect on the different recording parameter with respect to S/N ratio except for the 18sec 2vb2 sweep record, and the noise energy decreases with increase in the sweep number for the three recording different parameters.

- *Frequency Band Width*

Band Width(Hz)	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambient Noise before Attenuation
6-80Hz	-33	-25	-5
6-96Hz	-33	-27	-7
6-110Hz	-33	-24	-8
8-80 Hz	-32	-23	-9
8-96 Hz	-31	-22	-7
8-110 Hz	-32	-23	-9

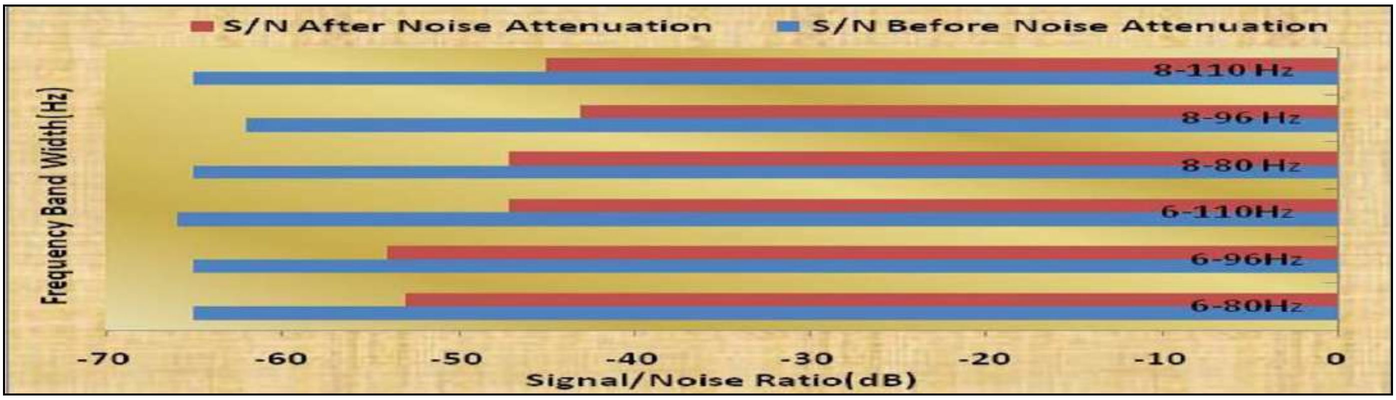


Fig 55 S/N Ratio Comparison on Frequency Band Width for 3D Vibroseis Records Before Noise Attenuation and After Noise Attenuation

We can observe from Figure 55 that the frequency band width between 8-96Hz and 8-110Hz shows the best signal to noise, therefore increasing the frequency beyond this range is not necessary and decreasing the band width will not give a better result, the noise energy is approximately the same for the whole frequency range. However, the frequency band does not have much effect to signal to noise ratio , rather it help in resolution and penetration of the energy to the target area. Looking at the figure you can see that there is no different in signal to noise for each band with.

- *Sweep Number*

Sweep Number	S/CriticalNoise before Atten uation	S/CriticalNoise after Attenuation	S/Ambient Noise before Attenuation
6-110Hz 18sec 1vb2sweep	-37	-25	-10
6-110Hz 18sec 1vb4sweep	-40	-28	-12
6-110Hz 18sec 1vb6sweep	-41	-30	-13

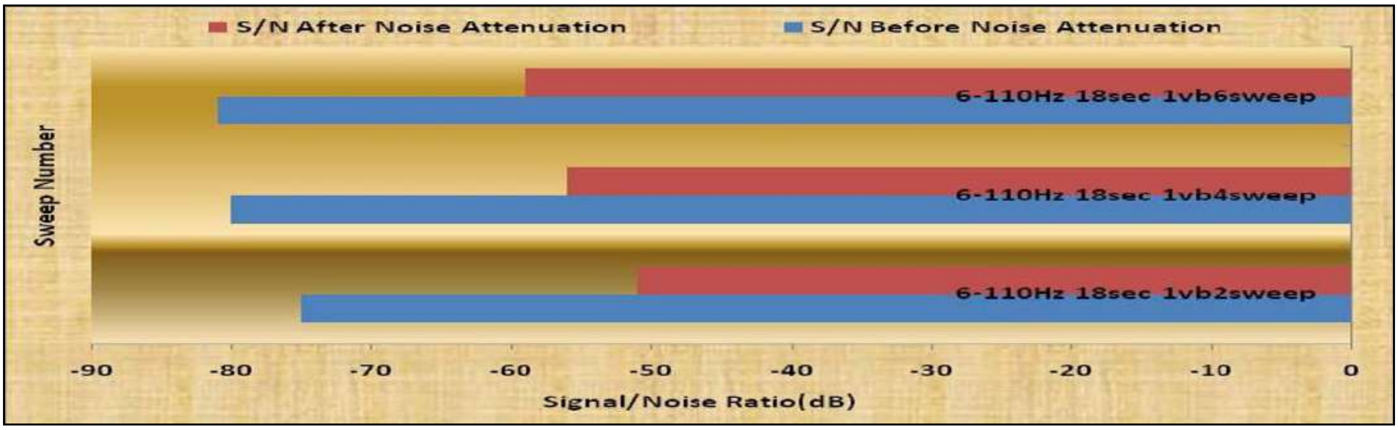


Fig 56 S/N Ratio Comparison on Sweep Number for 3DVibroseis Records Before Noise Attenuation, and After Noise Attenuation.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

We can see from Figure 56 that the signal to noise ratio increases with decrease in sweep number, and the noise energy is approximately the same for the same for the three recording different parameters.

- *Vibrosite Number.*

Vibrator Number	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambient Noise before Attenuation
6-110Hz 18sec 1vb2sweep	-37	-25	-10
6-110Hz 18sec 2vb1sweep	-33	-26	-12

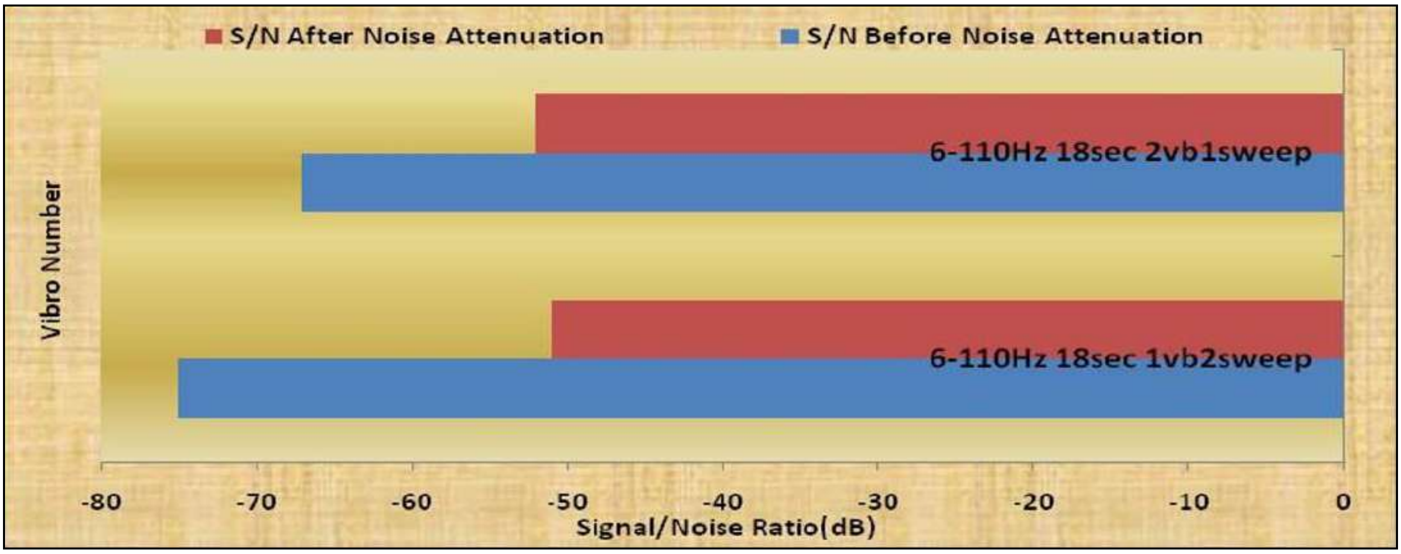


Fig 57 S/N Ratio Comparison on Vibro Number for 3D Vibroseis Records Before Noise Attenuation, and After Noise Attenuation

We can observe from Figure 57 that these two parameters shows the same signal to noise ratio, and the noise energy for the 1vib2sweep is higher than 2vib1 sweep for the two recording parameters.

Vibrosies Number	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambient Noise before Attenuation
6-110Hz 18sec 1vib4bsweep	-40	-28	-12
6-110Hz 18sec 2vib4sweep	-33	-24	-8

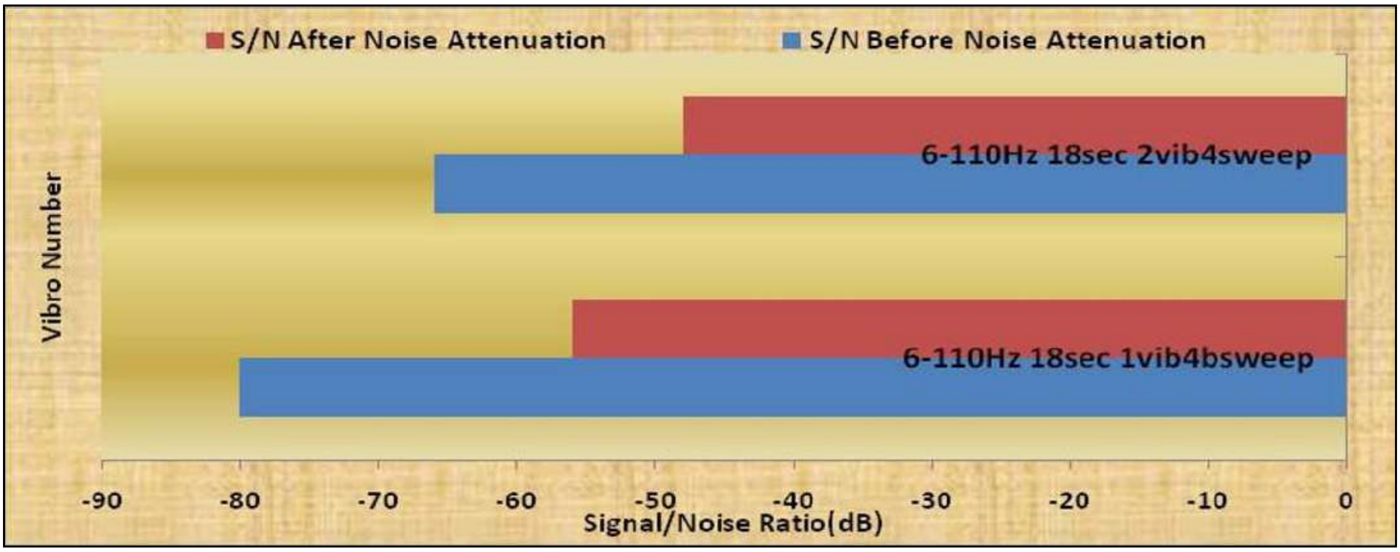


Fig 58 S/N Ratio Comparison on Vibro Number for 3D Vibroseis Records Before Noise Attenuation, and After Noise Attenuation

We can see from Figure 58 that the signal to noise ratio increases with increase in vibrator number, and that the noise energy also decreases as the vibrator is increase for the two recording parameters.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Vibrosies Number	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambiant Noisebefore Attenuation
6-110Hz 18sec 1vb6sweep	-41	-30	-13
6-110Hz 18sec 2vb4sweep	-33	-24	-8

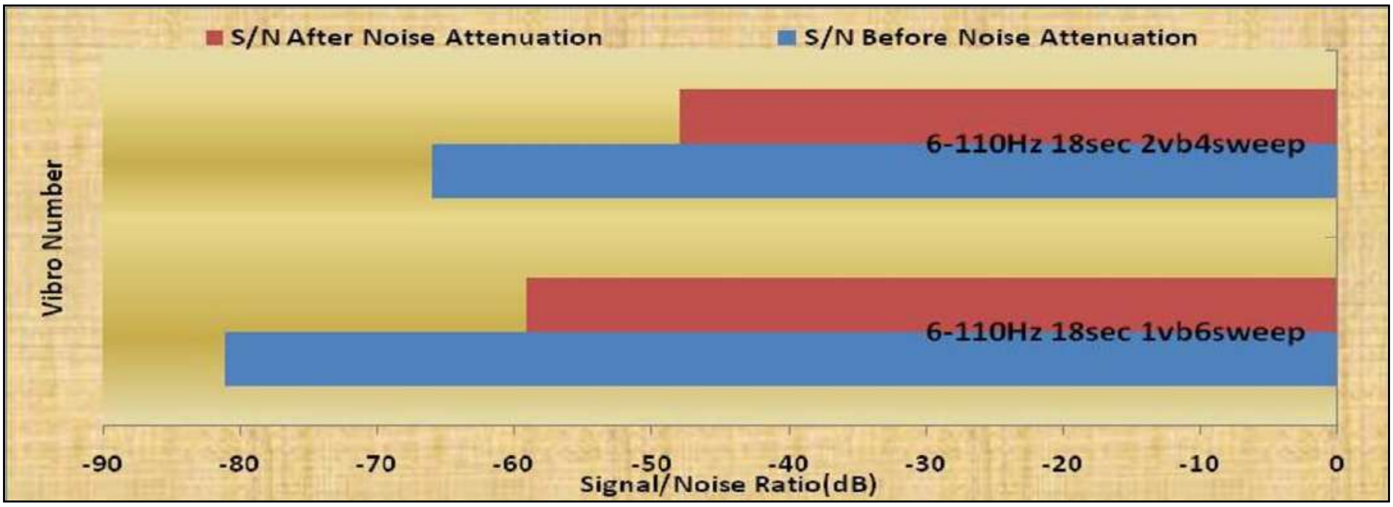


Fig 59 S/N Ratio Comparison on Vibro Number for 3DVibroseis Records Before Noise Attenuation and After Noise Attenuation

We can see from Figure 59 that the signal to noise ratio increases with increase in vibrator number, and that the noise energy also decreases as the vibrator is increase for the two recording parameters. Though the sweep number also varies, but with a higher sweep number of 6 the 2vib 4sweep parameter still give a better signal to noise ratio.

➢ *Comparing the Effect of Parameters to Critical and Ambient Noise.*

We can observe from the energy computer above that the ambient noise is mostly attenuated and the signal improve parameters for example; Sweep number, Sweep length and number of vibrators have no much effect to the attenuation of the critical noise (ground roll). We can also see from the analyses that the increase in this parameter increases the critical noise, but suppresses the ambient noise as shown in the computation table above. But, it help in getting a good resolution and there improving the fink-la image of the seismic record. Using the 2D record it will compare this parameters on the base of signal/ambient noise ratio.

Sweep Number	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambient Noise before Attenuation
6-110Hz 3vib1Sweep	-22	-10	198
6-110Hz 3vib 2Sweep	-21	-7	213
6-110Hz 3vib 4Sweep	-22	-6	224

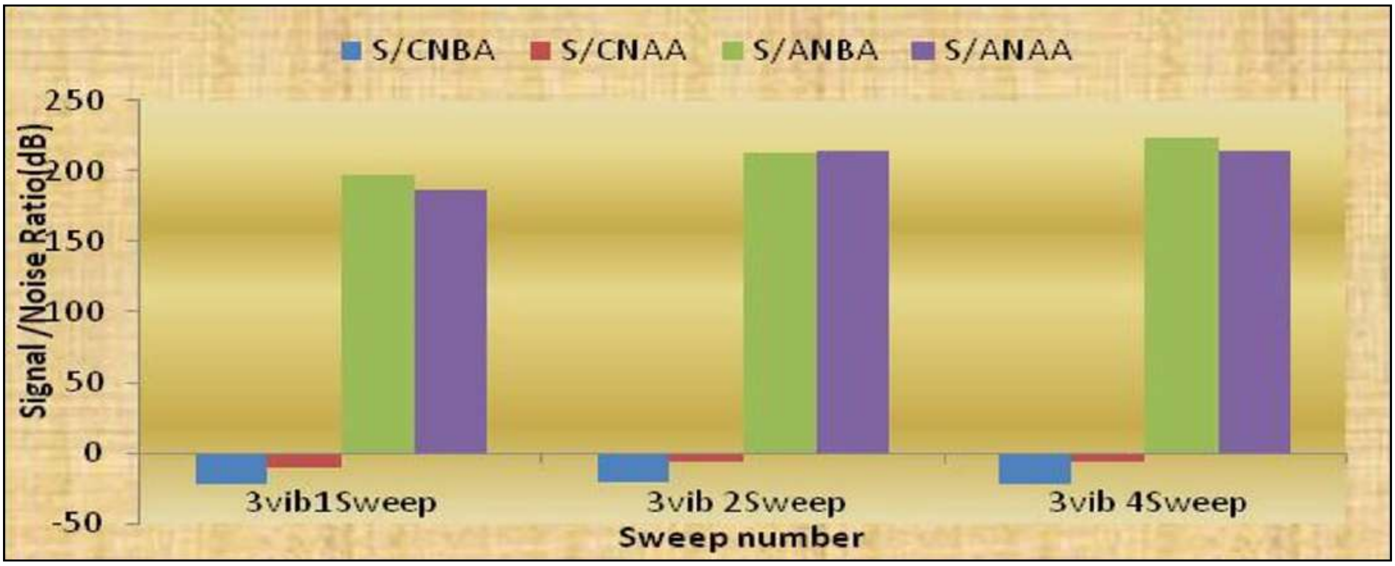


Fig 56 S/N Ratio Comparison on Sweep Number for 3D Vibroseis Records Before Noise Attenuation and After Noise Attenuation

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

Sweep Length	S/CriticalNoise before Attenuation	S/CriticalNoise after Attenuation	S/Ambient Noise before Attenuation
(12secs Sweep)	-26	-6	195
(16secs Sweep)	-22	-6	199
(20secs Sweep)	-22	-6	200

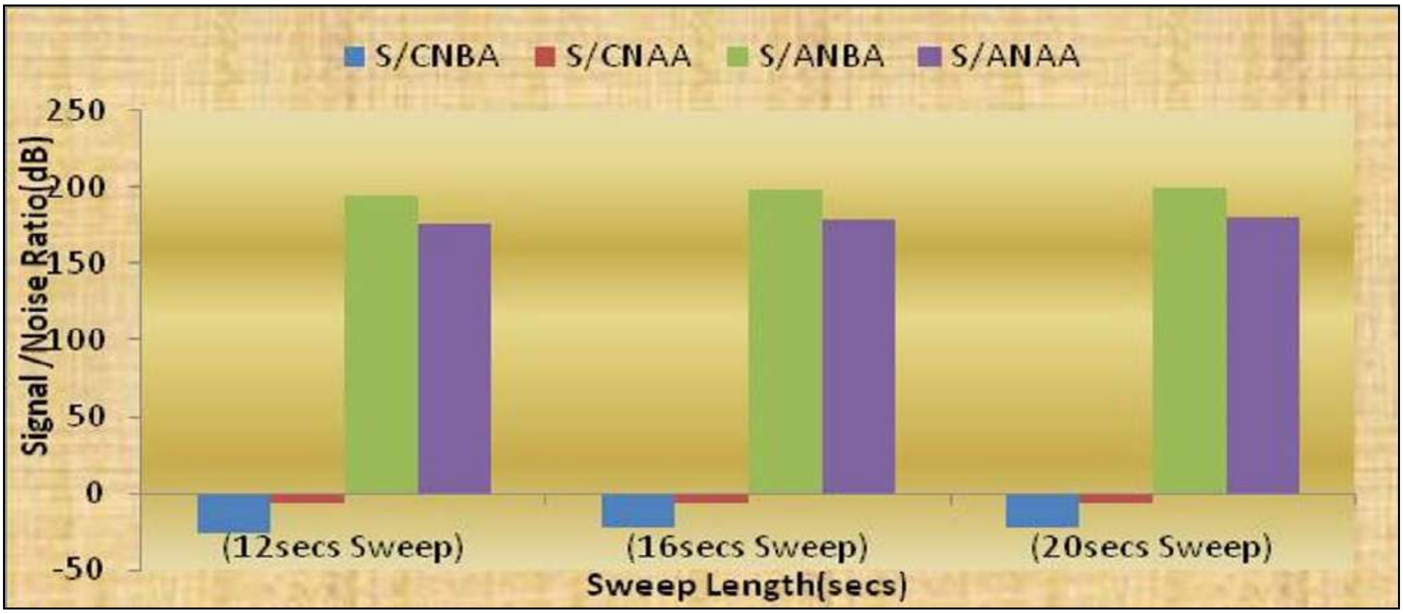


Fig 59 S/N Ratio Comparison on Vibro Number for 3DVibroseis Records Before Noise Attenuation and After Noise Attenuation

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

CHAPTER EIGHT
RECOMMENDATION AND CONCLUSION

➢ *Selection of Optimal Parameters for the Particular Survey Under Constrains of the Allocation Survey Costs*

Seismic acquisition is a very cost expensive project and no contractor will want to waste of the resources without achieving the aim of carrying out a survey. That is why it necessary to carry out parameter test before to ensure and find work ability of parameter base the target depth and the resource at hand. To be able to pick the optimal and best parameter we have to consider signal to noise ratio and and cost.

➢ *Charge Depth and Charge Weight*

From the analyses we can see that the signal to noise ratio increases with increase in the charge weight and we can also notice from the graphs that there is no big difference between the signal to noise for the different 2D explosive records parameters. From the graph and 2D S/N analyses I can suggest that 1kg charge weight well placed at a good depth with a good tamping is enough energy source.

➢ *The Charge Depth*

Is very important as it ensured that the energy penetrates down to the earth, but from the analyses we can state that the S/N increases with depth as shown in the computation. And that at 5m depth give a the same signal 7m depth. Therefore, I can state that 1kg depth charge well place in a 5m hole will be the best considering cost.

➢ *Number of Hole*

From the energy and S/N analyses it shows that 3by3 meter holes source has better signal to noise, this can be because the energy is evenly distributed and because the charges are split into small charges in the holes, this will give an elastic energy with a compression wavelet which will penetrate deeper into the ground. But will cost more than the 1 hole which will be very abrupt and the energy and will sometime create a big hole in the ground thereby not allowing the energy to penetrate well. I will recommend a 2 hole of 3m for this work considering cost.

➢ *Sweep Number*

Viewing from the analyses and result shows that the 2D vibrosies sweep number has no significant different when the sweep number is increases therefor I can state 3vibrator with 1 sweep source is a parameter good. For the 3D vibrosies records the sweep number of 1vib2 sweep gives a good S/N ratio as to compare to other. So choose it as give the optimal S/N with minima cost.

➢ *Sweep Length*

The sweep length of 12 sec is recommended after considering and comparing the results of the higher sweep length of 16, 18 and 20 seconds. Though increasing the time of sweep will help in the suppression of the ambient noise, but a good result can be achieved using 12secs sweep length, which takes less time and with minimal cost and affects the number shot. However, higher sweep length attracts more cost and increases the time spent per source point. Subsequently the same behaviour is experience in the 3D vibroseis record instead of higher sweep length i will recommend 14seconds sweep after considering and comparing the other higher sweep length.

➢ *Vibrator Number*

From the analyses we can observe that the increase in the number of vibrators increases the S/N ratio. After considering and comparing the various sources parameters for the 3D vibrosies records, I will recommend the 2vib2 sweep as the best for the project considering cost and it also give the best S/N ratio when compare with other parameters.

➢ *Frequency Band Width*

We can observed from the analyses and the graphs that there is no much significant different in the frequency band width. Basically the frequency band effect is in the level of penetration and not necessarily affects S/N ratio. It determines the resolution and image to be achieved at a seismic record. Nowadays broadband - spreading the spectrum to the low frequencies below 6-8 Hz - is mostly required because these low frequencies can penetrate deeper and taking the frequency down to 2Hz will enhance the resolution and the thus the final image.

➢ *Conclusion*

Seismic acquisition is a cost intensive project and each operator’s (oil companies) aim is to achieve a better result at best possible cost. This work tries to illustrate the need of carrying out a parameter test with aim of reducing cost at nearest minimum and achieving the target of the survey.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

At the end of these analyses, the aim is to review various aspect of acquisition parameter selection at 2D, 3D seismic surveys, two different data sets were used for this work, and were both recorded in the field. My aim was to illustrate on the bases of data analysis considering the costs and signal to noise ratio for each record and to prove that high cost does not necessary mean quality data acquisition. Is some cases time is wasted and resources is wasted. By carrying out these analyses I was able to save cost and the objective achieve. We can see from the above analyses and results that selection of the optimal sources was achievable at minimal cost.

ISSN No: 2456-2165 https://doi.org/10.38124/ijisrt/25jul175

REFERENCES

[1]. Cordsen, A., Galbraith, M., & Peirce, J. (1995). *Planning land 3-D seismic surveys*. Society of Exploration Geophysicists.
[2]. Yilmaz, Ö. (2001). *Seismic data analysis: Processing, inversion, and interpretation of seismic data* (Vols. 1–2). Society of Exploration Geophysicists.
[3]. Sheriff, R. E., & Geldart, L. P. (1995). *Exploration seismology* (2nd ed.). Cambridge University Press.
[4]. GEDCO. (n.d.). *OMNI 3D seismic survey design software* [Software]. Retrieved from https://www.slb.com
[5]. Geospace Technologies. (n.d.). *GSR wireless seismic data acquisition system*. Retrieved from https://www.geospace.com
[6]. Schlumberger. (n.d.). *VISTA seismic processing software* [Software]. Retrieved from https://www.software.slb.com/products/vista
[7]. Sercel. (n.d.). *428XL seismic data acquisition system*. Retrieved from https://www.sercel.com
[8]. Sensor Nederland B.V. (n.d.). *SM-24 geophone technical specifications*. Retrieved from https://www.sensor.nl