

## Seismic Data Analysis and Processing

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**Abstract:** Oil field exploration and reservoir interpretation of seismic data processing is put forward higher requirements, the previous means of conventional seismic data processing has been difficult to adapt to the needs of the high resolution seismic data processing and interpretation. Therefore, according to the characteristics of the raw data, discusses the several key problems need to be solved in high resolution processing, and developed a set of practical high resolution processing technology, expounds the rational utilization of noise before stack, amplitude fidelity, deconvolution and residual static correction processing technical problems to improve the resolution of seismic data. In the 3 d seismic block of daqing oil field data processing results show that the results section in the reflected wave group characteristics of clear, layer between the information rich, waveform nature is stable, the fault strike is clear, the breakpoint simply, can well meet the requirements of seismic data interpretation. That the interpretations of the experimental results also show that the key technology and process adopted by the design correct and reasonable, has the promotion value.

**Keywords:** Seismic data processing; the noise before stack; Residual static correction; Deconvolution; Velocity analysis.

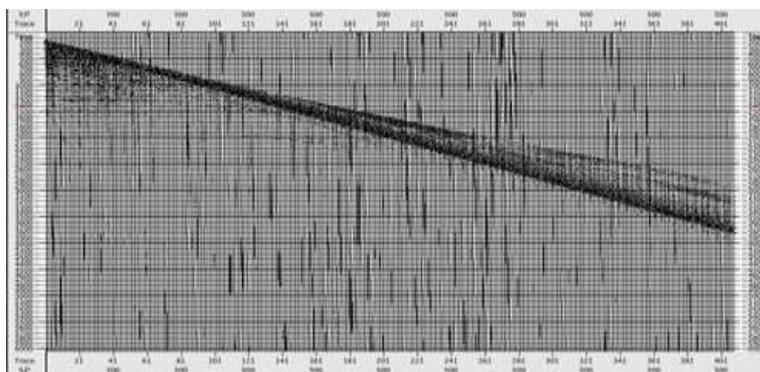
### SEISMIC DATA ANALYSIS

Seismic data type is segy type, the actual data is a two-dimensional sea, towing is collected, sampling interval of 4 ms, sampling points to 5256, a total of 1112 mm, 408 per cannon, receives is arranged on both sides in the shot point, asymmetric distribution, and minimum offset distance is 151 meters, maximum offset is about 5243 meters, maximum coverage times to 106 times, the intervals and interval are about 30 meters, frequency 50 hz, frequency band width of 20 to 60 hz. The data in the main effective wave as the surge,

and linear noise and multiple wave, vertical and horizontal to the energy there is biggish difference between energy change is bigger, the barrel of the gun. Through the initial profile can be found [1].

### Single shot records analysis

Browse single shot seismic data, the analysis in problems existing in the ChanBao record, can collect ChanBao record on visual information, provided a basis for further processing. As shown in fig-1 for the 500th gun single shot records.



**Fig-1: 500th gun single shot records.**

### The initial stack profile analysis

To simple initial raw data, analyze the stack section. As shown in fig-2

As shown in fig-2 analyze the initial stack section, can preliminarily summarizes the problems existing in the two-dimensional towing Marine seismic data [2]. Due to the presence of noise, the effective wave phase axis is not very clear. Maritime information multiple

wave development seriously. Deep seismic energy is weak, for large effect on imaging. From the bottom of the initial stack profile is elongated noise, large effect on the effective wave.

For the problems existing in the raw data, plans to begin to dry, from the energy compensation, multiple wave suppression of the main aspects for processing.

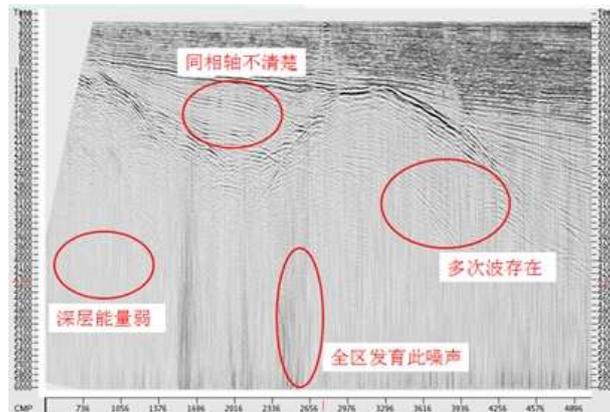


Fig-2: simple initial raw data, analyze the stack section

### The frequency of seismic data analysis

The original seismic data are analyzed in frequency. The classification of the distribution of different frequency ranges the signal and energy problems. As shown in fig-3 frequency analysis at the end of 500 the barrel of the gun. The Chan Bao on

different parts of the different components of the frequency analysis.

Figure 3 to swell noise frequency analysis, swell noise characteristics, low frequency, frequency of 0.5-2 hz, roughly 1 hz frequency, strong energy, distributed in the gun each time period.

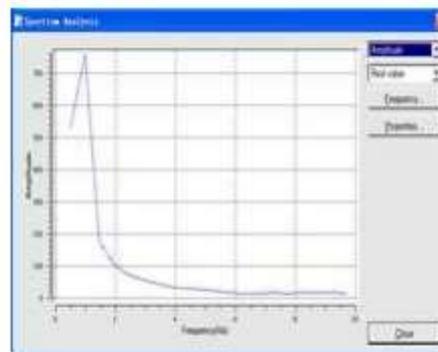
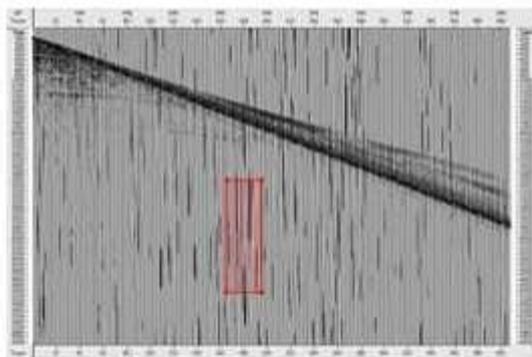


Fig-3: swell noise frequency analysis

Fig-4 for effective wave frequency analysis, high frequency, frequency band for 10 to 60 hz, roughly 50 hz frequency, uneven distribution of energy, are greatly influenced by noise, post processing are needed to improve the signal-to-noise ratio.

### The speed of seismic data analysis

Speed carries on the analysis of original data; this paper analyzes the gun record linear noise existing in the speed range, for linear noise suppression after analysis. As shown in fig-5.

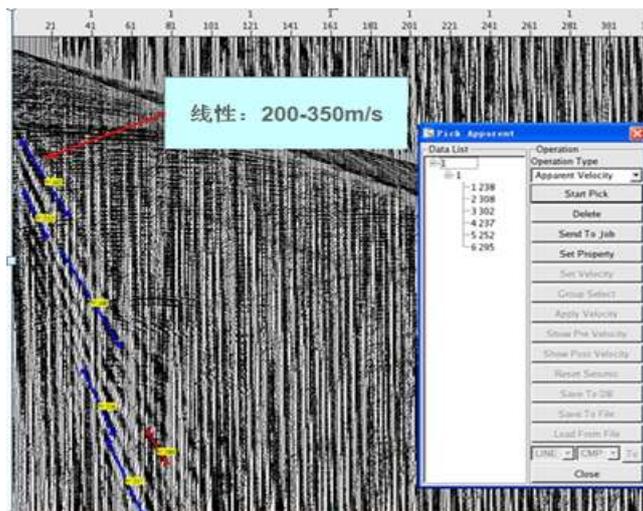


Fig-5: speed of seismic data analysis

**PROCESS AND PARAMETER OPTIMIZATION IS ESTABLISHED**

**The data load and observation system definition**

In Geoeast system for external input format seismic data, mainly through GeoSeisIO integration (interactive seismic data input and output) and GeoSeisInput modules to complete, there are also auxiliary module SegyInput and SegyOutput module to specialise in SEG Y seismic data format of input and output. Most of them are original SEG D Marine towing data format of seismic data, but because of the different field recording instrument, produce SEG D seismic data version is different, the first word of a slightly different number and location [3]. Application in the process of the original data input, GeoSeisInput GeoSeisIO default module, modules and the way of the head conversion template cannot satisfy the data read in the required head word transformation of key. , therefore, to understand the towing acquisition system of SEG D data format under the premise of the head word storage location, and use the GeoSeisIO module analysis and

determine the key word head word (periods, such as cannons, etc.) of line number of the position and length of the byte, application SegdDiskInput module will analyze the special way of corresponding load header information, can will be stored in SEG D way head or retrieve the information in the volume header, in order to meet the needs of the follow-up observation system definition.

Marine data by P1/90 (Marine navigation data with seismic data files matching relationship) were observed the system definition, Marine towing data, select cable (Fig-6), and then through the grid, the midpoint and bin calculation, quality control, replace the line name and update, complete observation system definition and seismic data, head replacement. But it is important to note that because the Geoeast system header does not support the character, so in front of the observation system load, head of the gun line need to seismic data road, match the P1 / data line 90, and thus for the normal observation system customization



Fig-6: observation system load interface

### Original data editing

In the process of actual field seismic record collection, because of the different excitation and receiving conditions, occasionally in some gun set or a monitor set records exist in waste gun or abnormal way, for this kind of situation we need for seismic data are spent shot filling zero or remove. The seismic record of bad detection point for this bad detection point we need to edit [4]. Running record editing is an essential part of treatment before work, this through the examination record every gun, found no need to edit the bad gun or a bad way, thus directly on to the next step of work.

### The noise before stack

Static correction technology application in land seismic exploration is critical, and in Marine geological survey, due to the seismic acquisition and receive all on the smooth surface, you can ignore the effects of static correction, so directly to the prestack noise suppression.

In reflection seismic exploration, seismic interference or noise refers to any other except a reflected wave seismic energy. For ocean exploration, the noise can be divided into coherent noise and random noise. Coherent noise mainly includes the hull, cable marking noise, the noise, a foreign body water birds hanging around obstacles of diffracted wave, etc.; Random noise is mainly wind, swell, airflow and biological disturbance of environment noise.

In the process of seismic data acquisition, due to external conditions and construction factors and instruments, and other factors, such as: arrangement way of combination, the combination of detector, methods and conditions, the receive condition, high voltage cable length, the outside world, mechanical vibration, acoustic, etc., so there are all kinds of interference on seismic records, such as surface wave, 50 hz industrial electrical interference, high energy random disturbance, coherent interference and random noise, etc.

The main interference wave in this data to swell, linear noise and multiple wave. So before stack noise is mainly in view of the above several, for other noise in actual data, the data showed no obvious. Noise exists in many domain data, cannon, CMP gathers, detection point sets and overlay data has its form of expression [5]. So we follow after the first energy in the process of noise suppression of the weak, high frequency low after the first, go to the rules, to the basic principle of the random disturbance, module of reasonable collocation, the noise by iteration and multiple domain denoising, achieve the purpose of purifying prestack data, improve the signal-to-noise ratio of data.

### The amplitude compensation

Affected by the geometric diffusion and the absorption of the earth, the spread of seismic wave in the underground medium process, the energy of the original earthquake records also exist certain differences in different regions. These changes had nothing to do with the underground geological information, easy to make explanation in myth, therefore, to take effective measures in dealing with the (i.e., amplitude compensation), to make up for the loss of the seismic record energy, improve lateral uniformity seismic record, and then the energy changes that make the seismic data, can truly reflect the underground reservoir lithology changes.

For the purposes of this data, because of the different excitation source, caused by gun between energy differences is very big. And the receive factor, the wave front diffusion, formation absorption, stratigraphic structure and the shape of the reflecting interface, all kinds of interference wave, etc. These factors at different positions in shallow, middle and deep reflection on the waveforms and energy, have much difference between trace or gun record waveforms and the energy is not the same [6]. The waveforms and energy of serious influence on deconvolution, dynamic correction and static correction and the accuracy of velocity analysis and so on prestack amplitude compensation is required.

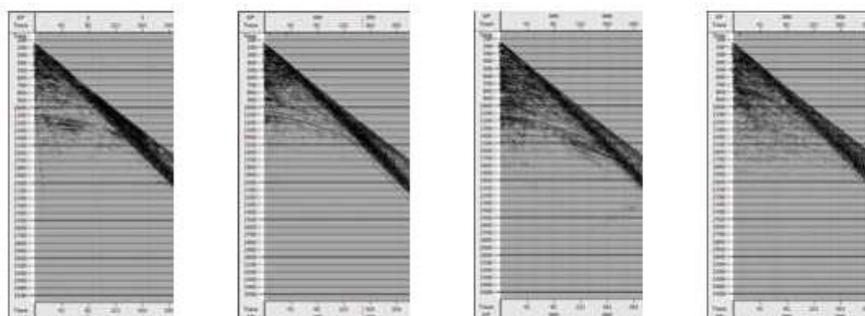


Fig-7: original single shot amplitude analysis diagram

① Single shot by looking at different position (as shown in figure 7) record found ChanBao energy level

gap is not big, because Marine source for air gun, compared with onshore explosive source, air gun source

is relatively stable, so the energy difference between the gun. Besides deep weak energy, found by superposition

of original data is hard to remove the imaging. As shown in figure 8.

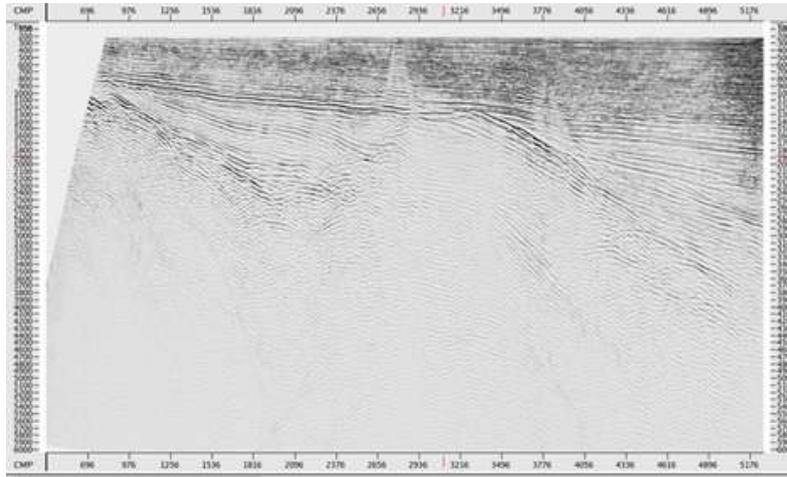


Fig-8: original stack section

② It can be seen from the original stack section, its weak amplitude energy than shallow to deep, because the original data, we don't have a suitable speed and so

on the vertical formation absorption compensation needs to be done. As shown in figure 9.

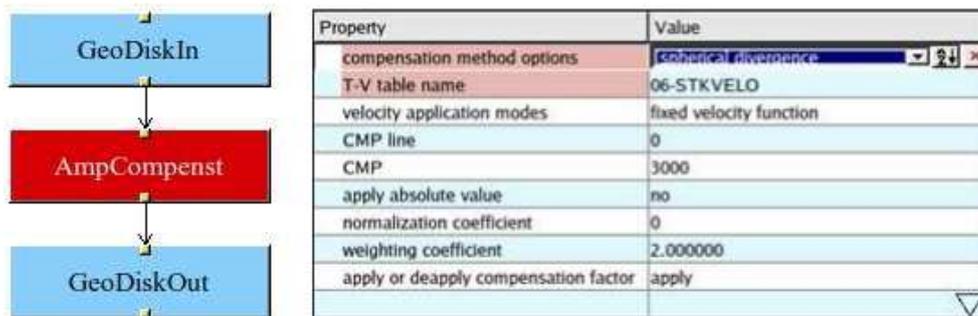


Fig-9: formation absorption compensation

③ After longitudinal compensation, on the horizontal, as a result of the near-surface severe ups and downs, so the energy is not balanced, the amplitude compensation

needs to be done, we adopt surface consistent amplitude compensation method of transverse energy to compensate. As shown in figure 10.

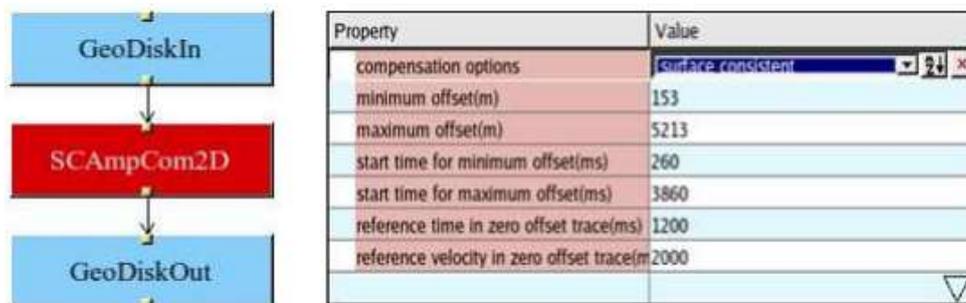


Fig-10: surface consistent amplitude compensation

④ Through vertical and horizontal upward amplitude compensation of energy, we can see on the stack section amplitude energy becomes balanced, compensated for the weak amplitude, strong amplitude under control, the entire section energy becomes uniform.

⑤ After formation absorption compensation and surface consistent amplitude compensation, with the progress of the treatment process, we got the stacking velocity, thus using picked up speed for the spherical spreading compensation data. As shown in figure 11.

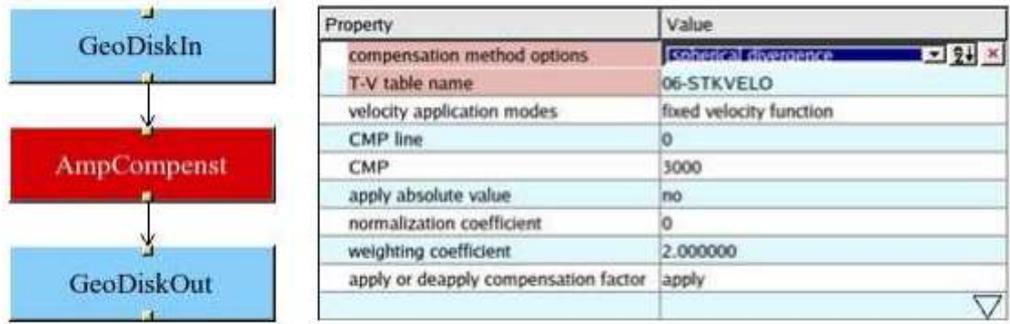


Fig-11: spherical spreading compensation

After amplitude compensation then end up with a compensation of stack section, as shown in figure 12,

you can see the deep energy has been effectively compensated [7].

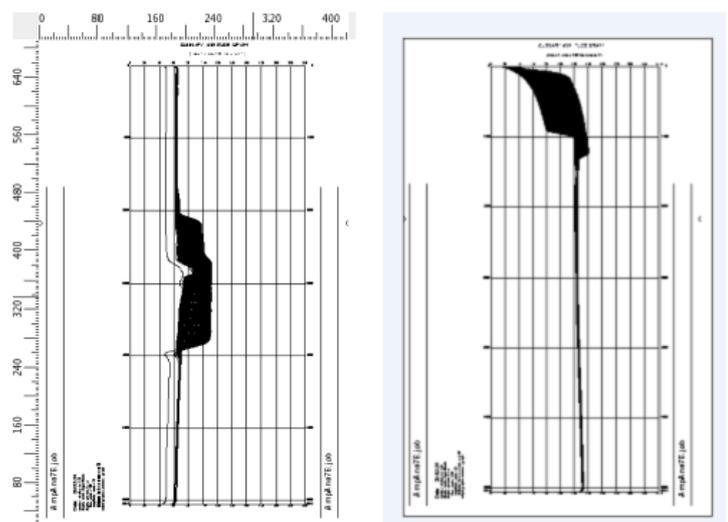


Fig-12: Before amplitude compensation, after amplitude compensation

After amplitude compensation then end up with a compensation of stack section, as shown in figure 13,

you can see deep energy has been effectively compensated.

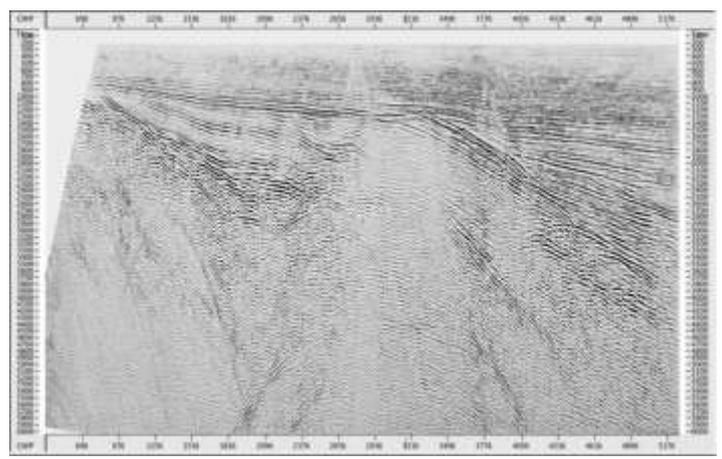


Fig-13: amplitude compensation after stack profile

**Deconvolution**

Affected by earth filtering function, the spread of seismic wave in the underground medium process, with the increase of propagation distance, resolution gradually decline. Pre-stack deconvolution to eliminate

the influence of the filtering effect and restore the reflection coefficient, improve the ability of earthquake records on the depiction of underground rock stratum [8]. To eliminate the different excitation conditions, conditions and the offset of waveform difference

(eliminate son due to the change of near-surface condition on seismic wave shape), consistent with wavelet transverse seismic trace. Application system of surface consistent deconvolution module for noise suppression and the amplitude compensation data for processing.

**TREATMENT EFFECT ANALYSIS**

The data processing is the key problem of noise removal, energy balance, the static correction and complex type precise velocity picking and complex structure imaging aspects problems [9]. After fine processing, the following overall in this paper, the results:

1. The towing seismic data for the sea, so you can ignore the problem of static correction, the process will focus on noise suppression, multiple wave suppression, speed of isolation.
2. Split denoising of ideas, through the analysis of selected control points distribution step by step to remove the original record is more difficult to remove

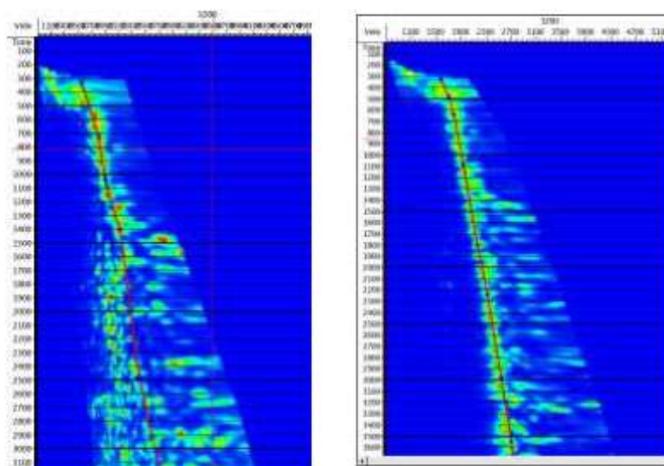
noise and improve the signal-to-noise ratio of seismic data. And has carried on the strict monitoring to denoising quality, makes the denoising process to minimize the damage of the effective wave, to achieve high fidelity.

3. Formation absorption diffusion, surface consistency and spherical spreading compensation, compensation for stack section on energy are well balanced, depth layer in phase axis get balanced, can display on a section at the same time, avoid offset arc problem.

4. After noise suppression and multiple wave of repression, speed spectrum picked up many times, the final velocity spectrum energy group is more concentrated, the accurate velocity field is obtained by profile real-time monitoring.

Through the above process, contrast horizontal stack section, summarize several:

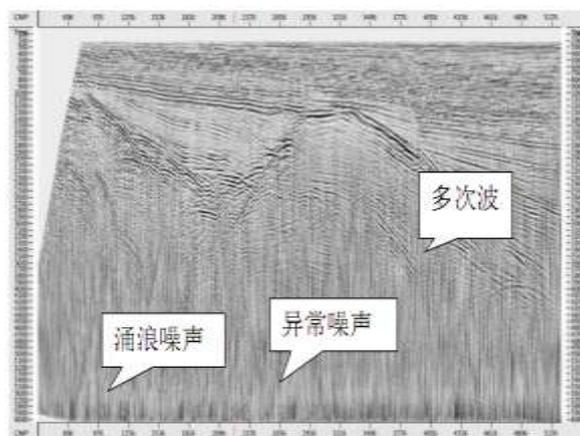
Multiple wave get down as shown in figure 14:



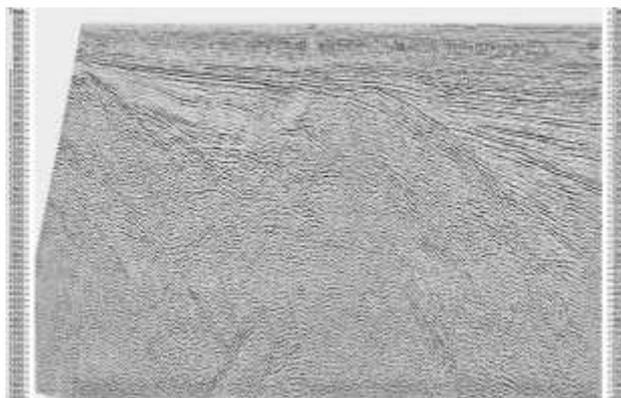
**Fig-14: A) wave suppression before many times, B) after multiple wave suppression**

Through the comparison, speed spectrum energy group multiple wave and good suppression. To suppress multiple waves, velocity spectrum energy is more concentrated.

Get to suppress noise in the profile as shown in figure 15 and figure 16:



**Fig-15: original stack section**



**Fig-16: stack section finally**

Original stack profile compared with the final stack section, most of the noise has been suppressed, to improve the quality section. By deconvolution, has improved the resolution of phase axis, remove the noise, the performance of the reflected wave is also more clearly [10].

#### CONCLUSIONS

1. Marine towing seismic data processing, the static correction problem is very mild, basic can be ignored, mainly for the surge suppression, noise suppression, multiple wave amplitude compensation and pick up speed.
2. Through the SRME, Radon, predictive deconvolution can get rid of the multiple wave is very good, the speed energy group is more concentrated, pick up more accurate.
3. The speed of the loot is an iterative process, through continuous to dry, deconvolution, removal of multiple wave and nmo correction and reactionary correction of these repeated iteration of the process, finally get the accurate velocity field.

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