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Virtual Reality and Computer-Aided 3D Seismic Exploration Data Acquisition Planning and Design System Optimization

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Abstract. Visualization techniques are techniques that use knowledge of computer graphics to process data and then render clear graphics for analysis and interpretation by the operator. Seismic exploration techniques used to find oil and gas deposits widely use visualization techniques to parse seismic data and graph geological aspects, making the analysis and interpretation of seismic data away from mere numerical tables and significantly more efficient and accurate, providing great help in locating oil deposits and estimating their reserves and exploration values. In this paper, the data is first imported and then read in a multi-threaded and multi-process manner according to two different mapping methods. The slices are mapped using two-dimensional texture mapping; bilinear interpolation is performed to ensure the mapping quality, and the overall mapping speed is faster; trilinear interpolation and front-to-back fusion are used in the light projection mapping process to obtain higher quality, but slower. The point cloud simplification was performed during the drawing of the layers, which can get a higher processing speed without affecting the imaging quality; the surface graphics were obtained by triangulation, and finally the graphics were optimized by using Kriging interpolation. The fracture display is performed by drawing a closed polygon to pick up micro-seismic event points. The micro-seismic event points are picked up by the priming method to test whether the event points are within the polygon, and the event points are picked up by each plane to ensure the correct rate.

Keywords: CAD intelligent system; virtual reality; computer aided; seismic exploration data
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1 INTRODUCTION

The use of seismic exploration technology for oil and gas exploration started early, with experiments using artificial earthquakes to measure seismic velocities in 1845, and its research and development has been going on for more than 100 years. The seismic exploration technology first performs artificially excited seismic, using the characteristics of different types of geology when the seismic waves encounter different types of geology because of their different physical properties and different travel directions and distances, and then collects and outputs the different signals generated by the geophone, and then interprets and processes the signals according to the dynamic characteristics of the seismic waves to obtain information about the structure and tectonics of the geological body and to estimate the oil and gas reserves [1]. The artificial seismic used in geophysical exploration can get high accuracy in finding the specific location of oil and gas, and its exploration depth can reach several thousand meters or more, which is much better than other geophysical exploration methods proposed by Kang et al. [2]. Along with the rapid development of the global economy, all countries are heavily dependent on oil and natural gas and their demand is increasing, and China is no exception. Although China has large oil and gas reserves, it still has huge energy extraction pressure with the dramatic increase in oil and gas consumption and the need for national energy strategic reserves by Hu et al. [3]. Moreover, the degree of detection and exploration of oil and gas resources in China is not enough, therefore, some complex and hidden oil and gas reservoirs will certainly become the main exploration objects in the future [4]. The increased difficulty of exploration has put forward higher requirements on seismic data processing technology, and the use of visualization technology can provide more accurate and complete interpretation of seismic data.

Since its introduction in the early 1990s, virtual reality-based visualization technology has been greatly developed through continuous in-depth research by scientists, and its core idea is to complete the conversion of data to graphics through modeling and rendering. Where modeling is first depicting data as geometric elements, and then calculating the luminance and color of the object projected to the observer based on optical principles, and then converting it to appropriate values for display on a display device. Jic et al. [5] proposed that the visualization technique has become a new means of interpreting seismic data due to its ability to present objects realistically and the additional interactive manipulation of objects, making it easier to gain insight into the patterns. Seismic data visualization constructs recognizable graphics through color, line, animation and other representations, which greatly helps professionals to analyze faults, stratigraphic lithology, reservoir parameters, etc. Previously, seismic data were interpreted using two-dimensional methods and processes, which had the disadvantage of not being able to restore geological structures accurately and efficiently [6]. Nowadays, abstract, complex and difficult to directly perceive geological formations are to be visualized and realistic, the object shape can be constructed by 3D modeling, and its internal structure can be visualized by texture, color and other information, which greatly improves the display of topographic structures [7]. Currently, the 3D capability in most of the seismic data processing and interpretation systems is mainly expressed in the 3D visualization function. The rapid progress of 3D visualization technology for seismic data will improve the efficiency of seismic exploration, provide strong support for oil and gas exploration, and continuously improve the economic efficiency and promote the long-term development of the country by Stognii et al. [8]. Seismic data processing has been developed for more than 60 years, during which time the equipment and methods used in seismic data processing have been improved due to the continuous progress of science and technology, especially the development of computer technology [9]. The main features are: the development from the previous exploration in flat terrain to the acquisition of data in complex terrain, the higher accuracy of the data obtained, the more precise processing results, the increasing types of information and the faster processing speed, which makes the exploration cycle of oil and gas much shorter. However, seismic data visualization still uses the traditional seismic profile model upfront, using waveforms, variable area maps, and variable colors to plot seismic data [10].

Multiple acquisition is a major exploration deployment idea for increasing reserves and production in key exploration areas, increasing proven reserves, and saving energy and increasing efficiency [11]. The joint application of old and new data can make full use of existing data and improve imaging quality. The fusion of high-precision seismic data from multiple acquisitions forms a set of multi-data fusion processing technology and process for the area of multiple 3D acquisitions, fully exploiting the valuable information of existing seismic data, better achieving the purpose of energy saving and efficiency, providing high-precision seismic data for reservoir prediction and well deployment in the area, facilitating the refinement of oilfield exploration and development, tapping the production potential of the exploration area, and improving the high-precision imaging of complex reservoirs. quality. Therefore, it is important to carry out methodological research on fusion processing technology to provide technical reserves and support for refinement of exploration and development. In this paper, we study the problems of static correction, subwave consistency, signal-to-noise ratio consistency, regularization of pre-stack data fusion, modeling and imaging in the area of multiple 3D acquisition, and form a set of multi-data fusion processing technology and process for the area of multiple 3D acquisition, so as to fully exploit the valuable information of existing seismic data and better achieve the purpose of energy saving and efficiency increase; and Provide a comparative evaluation of the multiple acquisition observation system, provide a reference basis and technical support for acquisition deployment, provide high-precision seismic data for reservoir prediction and well deployment in the area, enable new improvements in reservoir description and characterization technology, facilitate the refinement of oilfield exploration and development, exploit the production potential of the exploration area, and improve the quality of high-precision imaging of complex reservoirs.

2 ACQUISITION AND CONSISTENT FUSION OF 3D SEISMIC DATA

2.1 Computer-Aided Correction of Time Differences in Static Data

Static time differences consist of three main components: inter-block time differences, static correction time differences, and correlation time differences between old and new data. Using the time difference scanning technique, the relative time difference between the blocks of the primary collection of old data is first determined and eliminated; then the relative time difference between the secondary collection of new data is determined and eliminated; then, the application of the static correction technique is carried out, including field static correction and residual static correction. However, since there is no field static correction data for the old primary collection, only the surface consistent residual static correction can be applied, and this results in a null-variant floating time difference (caused by changes in the low descent velocity band) between the new information and the secondary collection. Therefore, finally, the first and second collection data have to be intercorrelated to find the floating time difference and apply it to the primary collection data to completely eliminate the time difference between the two. The uniformly calculated static correction volume is decomposed into a low-frequency component and a high-frequency component, and only the high-frequency component is applied before the velocity analysis of a single block of seismic data. By using a unified static correction volume calculation for the whole area, the time difference problem and boundary effect of inconsistent correction volume at the collocation due to the static correction volume calculated separately for different blocks can be avoided. The multi-block joint static time difference correction technique mainly corrects the systematic time difference and floating time difference problems between multiple acquisition blocks. Due to the differences in acquisition time and method, for example (different well depths, different geophone burial depths, different excitation acceptance methods), each block usually needs to be processed separately to form a superimposed profile and then correct the systematic difference; after the systematic difference correction, the floating time difference will still remain due to the difference in the selection of the floating reference surface for static correction, and the laminar static correction technique of unified multi-block near-surface velocity model is needed to eliminate the effect of floating time difference. The effect of floating time difference is needed to eliminate the effect of floating time difference. In this paper, the following processing flow is established to solve the inter-block time difference problem as shown in Figure 1.

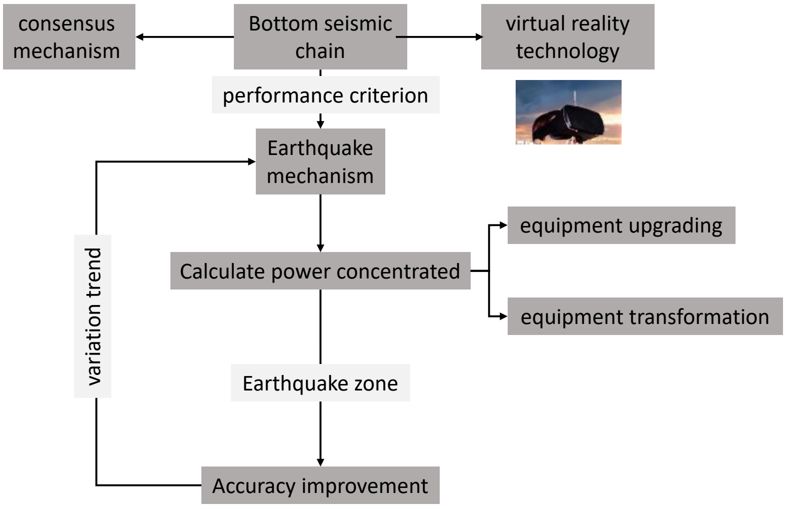

Figure 1: Flow chart of multi-block joint static time difference correction.

The basic theoretical basis for laminar static correction is the Fermat principle (seismic wave propagation paths follow minimum time) and the object of study is the first-to-waves that are closely associated with the surface structure. In the inversion of the laminar imaging model, the definition of first arrivals is broad, including direct waves, refraction waves, refraction waves and waves that reach the surface first after the combination of several waves. The process of laminar static correction consists of three major steps: (i) establishing a near-surface model; (ii) from the given near-surface model, performing orthorectification and obtaining the first arrivals of the model by ray tracing; (iii) comparing the calculated first arrivals with the actual picked first arrivals to calculate the corrections of the surface model, and finally obtaining a more accurate surface model after several iterations. When solving the laminar static correction problem, there are two types of algorithms: first, the inverse problem is solved by the inverse problem; second, the inverse problem is solved by the positive problem. The former is to use the inverse operator to invert the internal covariance of the object directly through the data, while the latter is to first give an initial quantile function, calculate the integral value of this quantile function over the manifold, compare the calculated integral value with the true integral value to obtain a difference, and use the difference to modify the original quantile function to obtain a new quantile function. Repeat the above process until the calculated integral value agrees with the true integral value, at which point the obtained quadratic function is considered to be the true quadratic function to be inverted. In this paper, the inverse problem is solved in this way by using the positive problem.

2.2 Virtual Reality-Based 3D Display Technology

Virtual reality applications are cross-platform and can be easily ported between platforms, while virtual reality has the advantage of efficient execution and ease of operation. Its widely used features are as follows.

1. graphics modeling: to facilitate development and provide efficiency, you can directly call the virtual reality graphics library of points, lines, polygons and other geometric shapes in the drawing function, such as glRectf () function can draw rectangles, the function parameters can control the geometry size, location and other attributes; you can also directly draw complex graphics, such as plane polyhedra.

2. transformations: virtual reality transformations include the most basic three-dimensional transformations in computer graphics, namely geometric transformations, projection transformations, cropping transformations, viewport transformations. These transformations can be operated through the virtual reality function interface.

3. Color, lighting, and material settings. Realism is an important indicator of 3D image display. Light and darkness and color to determine the lighting and material effects on the object realism has a great impact. Virtual reality can set the color for RGBA mode or color index mode; can also set the light source and material, glLight () function to set the light source parameters, glMaterial () function to specify the material parameters for the lighting model, glColorMateria () to make the material color tracking the current color. From the above you can see that the object is more three-dimensional when setting the light source and material, close to the real observation.

4. texture mapping. Virtual reality can be achieved by pasting the picture to the specified location in three-dimensional space, directly completing the three-dimensional image drawing, and the image effect is better. In this process can also use the GPU to accelerate the drawing, saving the drawing time.

5. Enhance the picture quality. Virtual reality comes with anti-aliasing, fusion, fog and other image processing functions, which can make the drawn objects more detailed and realistic picture quality.

6. Double cache. In order to play animation, virtual reality provides double cache function, which means setting two caches, one for drawing image and one for displaying image, and controlling the refresh frequency when displaying, so as to realize the playback of animation.

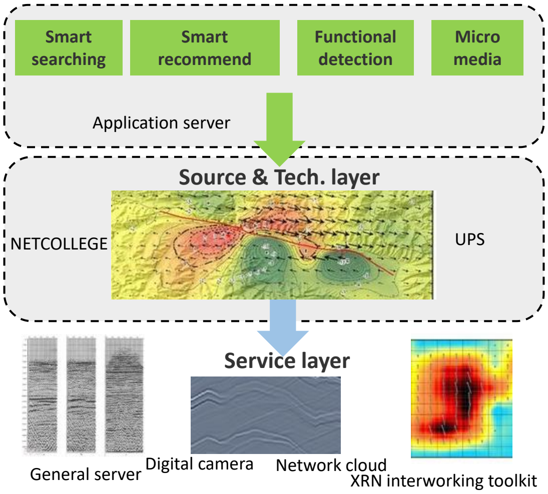

Figure 2: Graphical drawing data reading for virtual reality simulation.

The seismic data pre-processing is the basis of the whole visualization system. Only through the data pre-processing can we build a model that accurately reflects the geological area and then we can carry out the subsequent work of 3D visualization of seismic data. Therefore, when processing data, we should first consider how to import and read the data. The data files should be loaded into the data tree for classification management before data reading. The data import includes single data import and multiple data import. In the process of importing, the selected data will be judged, and if the data file already exists under the corresponding node, the existing data will be deleted and other remaining files will be imported; if a mismatched data file is selected, the corresponding file can be deleted in the data file display window before determining the data to be imported, and then the data management tree will be imported while update the database. The QTreeWidget class is used to organize the data in a tree structure after the import. The class diagram for data reading is shown in Figure 2.

2.3 3D Seismic Data Visualization Design Solution

In this paper, we want to build a three-dimensional spatial model, as shown in Figure 3, a rectangular three-dimensional frame is designed on the UI, there is a three-dimensional coordinate system in the frame, and there are directional markers in the upper left corner to switch the position. On this basis, the data can be cut according to the measured line or horizontal plane direction to draw a slicing graph; the spatially discrete points inside the layer data can be connected into a surface to draw an undulating layer; the micro-seismic event points can be projected to get, and selected and colored.

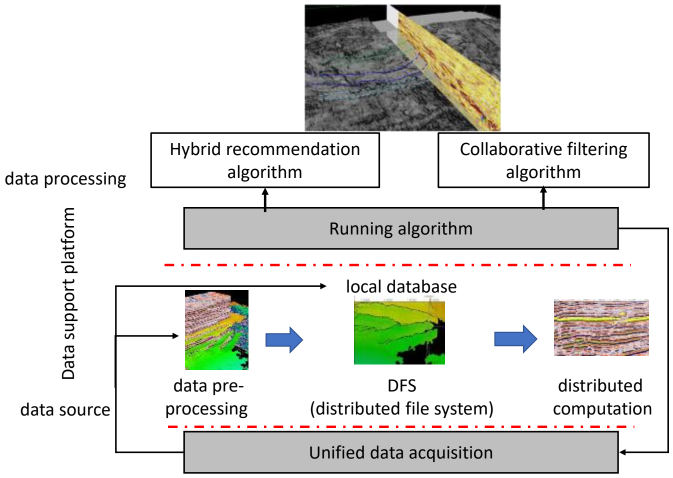

Figure 3: Three-tier architecture diagram.

Considering that this paper organizes and processes seismic data before mapping it, a three-layer architecture approach is used to design it. The three-layer architecture refers to the representation layer, the business logic layer, and the data access layer, with downward dependencies between its layers and the underlying layer provides support to the upper layer without the need to understand its content, which is adaptable to changes and easy to operate. In the three-layer structure, the representation layer outputs graphical results, on which the user can only perform operations such as double-clicking the mouse or dragging and dropping the window, after which it gets a response in the main frame and then passes the events to the business logic layer. The tasks of the business logic layer are problem-specific operations: for example, putting the read data into the required data structure, or interpolating the original data to calculate the new data, which solve functional problems belong to the business logic layer. Providing interfaces is the main task of the data access layer, i.e., reading and extracting relevant data information from existing standard data formats and saving them in the database for use by the business logic layer; it is also possible to manipulate the database directly during mapping or other activities, performing operations such as adding, deleting, and checking.

The slice display module can first import the data, set the plotting parameters, model and plot the Seg-y and other data, and the plotting includes both texture mapping and ray projection. The steps are to select the corresponding window by clicking on the menu bar inside the main interface, select the seismic file to be displayed that has been imported into the tree menu, and configure the parameter dialog. Then, according to the speed and quality requirements, choose different drawing methods to plot the data graph in the x, y and z axis directions; you can click the right mouse button to set the cut surface you want to display in the pop-up options. A layer can be regarded as a spatial surface, which contains various data points with three-dimensional spatial coordinates, data processing, through the feature point judgment to simplify the data; layer display needs to connect the scattered data points in the layer into a smooth surface, coloring the data points, using the color scale according to the depth worth to different colors, through this method to draw out the layer graphics in the depth of a color gradient process. The operation requires first reading the layer data, then activating the corresponding display window, selecting the layer data, and clicking on the button to draw it directly. The 3D model of the fracture display module is created according to the parameters input by the user. The event point display is to read the micro-seismic data, get the event point coordinates, magnitude and other information, determine the position on the plane according to the determined time, determine the size of the sphere according to the magnitude, and can be colored; pick up the event points by recording the mouse events to get the points on the plane and form a polygon; the fracture drawing first needs to determine the event points in the polygon Set, after filtering event points in three directions, then generate a special crack data file through the 3D crack interpretation function to get the basic information of cracks, and then display the cracks in the 3D environment.

3 3-D DATA ACQUISITION PLANNING AND DESIGN

3.1 High Precision Imaging

The target area selected for this study is the Puguang area, the overall quality of the data in this prospect is good, only the tectonic boundaries and negative tectonic zones are poorly imaged. The seismic data fusion technology makes full use of the existing seismic data information to form a targeted series of multiple 3D fusion processing and separate processing imaging techniques to further improve the processing quality of the old oil area and provide a basis for further acquisition deployment.

Velocity analysis is an important part of seismic data, and its accuracy directly affects the quality of the superposition and the imaging effect. Only when the velocity function is clarified can processing and interpretation be guaranteed.

1) Using full-interaction velocity analysis software, the velocity spectrum, superimposed segments, dynamic correction channel set and control superimposed profiles were compared for a comprehensive analysis to find the accurate superimposed acceleration (Figure 4).

2) Fine velocity analysis and 3D surface consistency residual static correction iterations Velocity field accuracy is the most direct factor affecting the quality of the results; therefore, improving the velocity field accuracy is necessary to improve the quality of the processing results. Three iterations of conventional velocity analysis and residual static correction are used in the processing to eliminate the influence of static correction amount on velocity and gradually improve the velocity analysis accuracy.

The main part of the work area is fractured, with small and complex fracture blocks, so the winding waves near the fault surface are developed. The DMO superposition can image the strata with different dip angles, effectively avoiding the dip filtering effect of the NMO superposition, and thus obtain a more accurate DMO velocity spectrum. The DMO velocity analysis results in a more accurate root-mean-square velocity field, which provides an initial velocity model closer to the true velocity of the formation. The defects of the conventional velocity analysis method are firstly, the accuracy of velocity analysis is not enough, the velocity analysis cannot be carried out for each point, and human intervention is required, point-by-point velocity analysis can carry out velocity analysis for each point, and the computer picks up the completion automatically, which greatly reduces the human workload and the velocity analysis density can be greatly improved; secondly, after the normal time difference correction of the conventional velocity analysis method, the far offset distance rally will have insufficient correction amount, Stretch distortion, anisotropy, non-double curve and other phenomena. The point-by-point velocity analysis technique overcomes these shortcomings, it firstly finds a velocity in the near offset distance channel set, finds a correction amount in the far offset distance according to the near offset distance zero offset distance time, so that the far and near offset distances are calibrated to the same level, and finally corrects the middle offset distance, so that the far, near and middle offset distance channel sets are all calibrated.

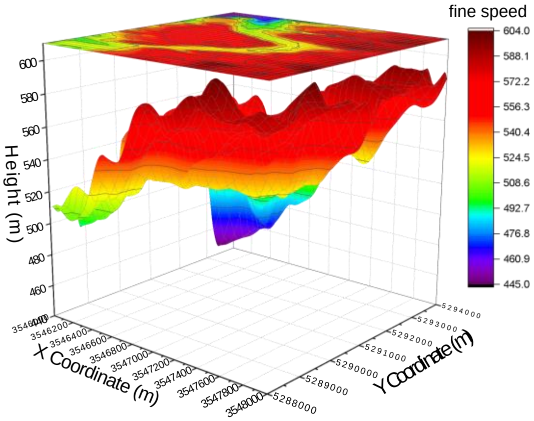

Figure 4: Interaction fine speed analysis.

3.2 Pre-Stack Time Offset Processing

Due to the fusion processing, there are multiple obstacles on the ground within the work area, and there is a serious problem of uneven distribution of offset distances throughout the work area, which leads to uneven distribution of coverage times throughout the area, resulting in a serious pre-stack time offset drawing arc phenomenon, which affects the imaging effect. Therefore, it is necessary to regularize each offset distance channel within the pre-stack channel set so that the energy provided by each facet element within the offset distance does not differ greatly, thus eliminating or weakening the offset drawing arc phenomenon caused by the large difference in coverage times and maintaining the fidelity of seismic attributes. The 3D Fourier transform technique, using channel binning plus channel interpolation in the F-X-Y domain, can be interpolated on the CMP channel set as well as on the co-offset distance channel set based on the assumption of regular grid input. After the data regularization process, the reflection points within the surface element are at the center point and the coverage count is effectively improved. Where near-offset distance information is missing due to wild over obstacles, it is compensated to some extent. From the overlay effect, the shallow isotropic axis continuity is improved more obviously after data regularization, and the deep isotropic axis continuity is also enhanced. Figure 5 shows a comparison of the posterior elements before and after face element centration, with the centroids all falling within the center of the face original.

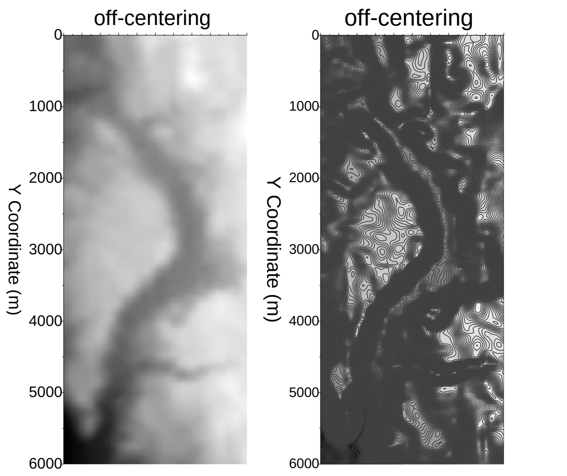

Figure 5: Comparison of faceted elements before (left) and after (right) facet centrality.

The key parameter affecting the pre-stack time offset is the offset aperture. The selection of the offset aperture often determines the offset effectiveness and offset efficiency; too large an aperture selection will affect the offset speed, while too small a selection will result in insufficient sampling in the horizontal direction and false frequencies in the offset results. The pre-stack time offset aperture is controlled by three factors: the determined maximum reflection interface inclination angle, the input data channel length, and the travel-time aperture. The offset aperture is the range of the spatial distribution of seismic data involved in the imaging of the offset around the shot point, and in the Kirchhoff integration method pre-stack time offset algorithm, the offset aperture is the interval used for the integration calculation. In general, in places with large stratigraphic dip, the input area should be more than one-third larger than the output range to achieve a more desirable imaging effect. An excessively large offset aperture not only increases the offset work unnecessarily, but also introduces offset noise, which has a serious false frequency and reduces the signal-to-noise ratio and affects the quality of the offset results; if the offset aperture is too small, the steep dip stratigraphic reflections are not fully imaged. Usually, to ensure the quality of offset imaging, it is required that the offset aperture must contain the main energy part from the subsurface reflection point, and the main energy satisfies Snell's law of geometrical optics (the angle of incidence is equal to the angle of reflection). In order to improve the imaging quality, the seismic data should be selected in the imaging process with the coherence band (bypass band, Fresnel radius) centered on the main body energy, which can ensure the tectonic accuracy in the imaging results and also improve the signal-to-noise ratio of the seismic profile. Theoretically, it is possible to determine the optimal aperture location based on the time difference between the reflected and bypassed waves, but in practical data processing applications, it is difficult to achieve this, mainly because it is difficult to accurately calculate the reflected wave travel time at every point in the subsurface. It is more difficult because the calculation of the reflected wave travel time not only depends on the velocity model, but also on the tectonic dip angle at each point in the subsurface. Only when the tectonic dip angle is accurately given can the reflected wave travel time be reliably calculated.

The pre-stack time-offset velocity model is built with the criterion of co-imaging point (CIP) tract set primary reflection wave in-phase axis flattening. The offset velocity is obtained iteratively by first using the stack acceleration as the initial model, smoothing it to maintain the longitudinal and lateral velocity trends at each velocity control point, and then performing a pre-stack time offset on the data to output the velocity control line CIP channel set, at which point the CIP channel set in-phase axis is not flattened due to velocity inaccuracies, manifesting as over or under offset velocity. Using the interactive velocity analysis system in the processing system, the resulting CIP channel set is analyzed for offset velocity to obtain a more accurate offset velocity field. The re-adjusted offset velocity is shifted a second time to obtain a new velocity control point CIP channel set. The remaining velocity analysis of the new CIP channel set can be performed to obtain more accurate offset velocities and complete a new round of velocity iterations. After several iterations according to the complexity of the data geological structure, the offset velocity point CIP channel set is flattened to get a convergence satisfactory time domain offset velocity, and finally, local adjustments are made in a small area to improve the accuracy of the velocity analysis based on the improved geological understanding. When the velocity field correction is performed in the stack, the newly obtained offset velocity field should be continuous and smooth, as shown in Figure 6, which maintains the trend of the offset velocity field, such that the offset velocity makes the offset results do not cause sudden local changes in velocity to cause homophase axis misconnection.

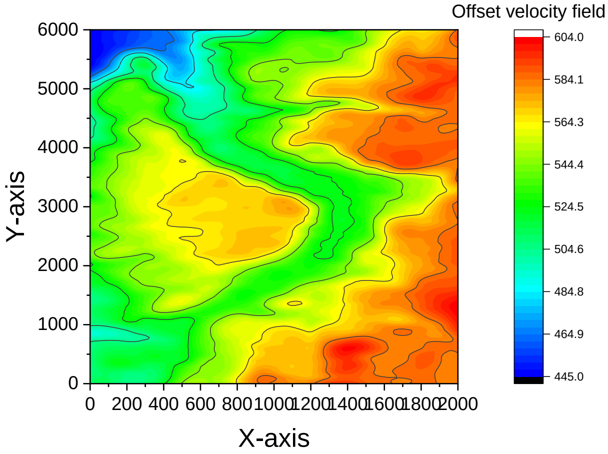

Figure 6: Variation of the offset velocity field.

For the problem of complex ground surface and static correction of low drop velocity zone: this processing adopts Omega processing system's field elevation correction and first-arrival refraction wave static correction method, this processing means retains its elevation information better while using single gun pickup to get accurate first-arrival time for accurate calculation, calculating the high-frequency correction amount and low-frequency correction amount of each gun point and check wave point and recording this information into each gun and In this way, the calculation can be better checked without changing the original information, and the iterative process of check-pickup-calculation-check again can be carried out; on the basis of the test of elevation static correction, refraction wave static correction and laminar inversion static correction, the Laminar static correction technique, theoretically laminar static correction is a curved ray static correction method that treats the surface model as an arbitrary medium, it does not restrict the surface elevation difference, low drop velocity zone velocity and refraction interface, and is more suitable for areas with more complex surface structure. The combination of primary and residual static correction in the field successfully eliminates the influence of the static correction amount on the data and achieves better results, as shown in Figure 7. In the present processing, elevation static correction, refraction static correction and stratigraphic inversion correction tests will be conducted, and either stratigraphic inversion static correction or refraction static correction will be selected according to the test results, and the first-to-first pickup will be carried out for single guns in the whole area, and the static correction amount will be calculated uniformly.

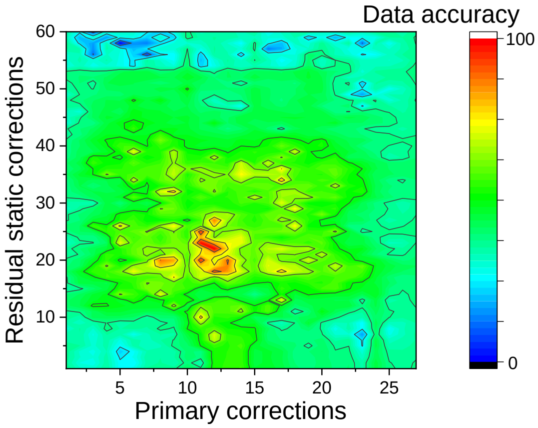

Figure 7: Effect of primary and residual static corrections on data accuracy.

For amplitude compensation, the processing idea of combining traditional spherical diffusion compensation and surface consistent amplitude compensation techniques is adopted, which is also based on the classic of fidelity and amplitude processing. Since this processing is a fusion processing, including two different 3D raw materials, especially different years and different collection systems collection, although the energy at the survey joint is basically the same, but in order to maximize the fidelity and amplitude, in addition to the spherical spreading compensation and surface consistency compensation, a finer consistency processing of the amplitude at the joint is also performed using the matching filtering technique.

4 CONCLUSION

Starting from the origin of fusion processing and the current exploration needs, this paper analyzes the current development status and technical bottlenecks of processing technology for complementary multiple acquisition information, conducts targeted profiling with blocks and targets of secondary 3D acquisition, and proposes that research and analysis applications of systematic fusion processing are urgently needed at present. To address the seismic data fusion problems in the multiple 3D acquisition region, we carry out subwave consistency technology, multi-block static time difference correction technology, signal-to-noise ratio consistency technology, and pre-stack data fusion regularization technology to form a set of multi-data fusion processing technology and process for the multiple 3D acquisition region, and finally conduct trial processing on the actual data in the target area to verify the effectiveness of the technology, and analyze and evaluate the processing results and the multiple acquisition The results and the multiple acquisition observation system are analyzed and evaluated. In this paper, the data is read by first importing the data and then using multi-thread and multi-process according to the two different mapping methods. The texture mapping body is drawn using a two-dimensional texture mapping method to draw the slices; to ensure the drawing quality, bilinear interpolation is performed in the drawing process, and the overall drawing speed is faster; the light projection body is drawn using trilinear interpolation, and the fusion method from front to back, and the quality obtained is higher, but the speed is slower. The point cloud simplification was performed during the drawing of the layers, which can get a higher processing speed without affecting the imaging quality; the surface graphics were obtained by triangulation, and finally the graphics were optimized by using Kriging interpolation. The fracture display is performed by drawing a closed polygon to pick up micro-seismic event points. The micro-seismic event points are picked up by the priming method to test whether the event points are within the polygon, and the event points are picked up by each plane to ensure the correct rate.

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