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# A research on the reservoir prediction methods based on several kinds of seismic attributes analysis

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***Abstract:*** **-** Seismic attribute analysis method is one of the important technology which can identify, select ,descript and evaluate entrapment, its main goal is to provide the basis for reservoir prediction. Due to many seismic attributes are related to reservoir characteristics, as some attributes characteristics of the reservoir are more sensitive than the others, some attributes can well explain the abnormal underground which is not easy to detect, it shows that the feasibility of seismic attributes for reservoir prediction. To this, this article analysised conventional seismic amplitude attribute, the grey correlation properties, the attribute fusion applicability on X area SII small unit level, and come to the conclusion that different kinds of attributes response in different types of reservoir, thereby we got a deep understanding of the feasibility and accuracy on different seismic attributes. From the research, the X area SII reservoir was provided a favorable method for reservoir prediction, for subsequent use of seismic attributes for reservoir prediction research work laid the foundation.

***Keywords:*** *- Conventional seismic amplitude attribute, The grey correlation properties, The attribute fusion applicability, Reservoir prediction*

## I. MECHANISM OF SEISMIC ATTRIBUTES

Seismic attribute analysis method is trap identification, one of the important technology of optimization, description and evaluation, and can realize the quantitative description of sedimentary body volume, lithology, etc. Because of the existing oil and gas reservoir in the basin are relatively thin, most of the reservoir is located in less than a quarter wavelength range of seismic resolution, the question which is under the condition of less than the seismic resolution limit for reservoir research is particularly outstanding. When the thickness of the thin layer reservoir less than 1/4 wavelength, there is tuning amplitude change of seismic wave, the simultaneous tuning amplitude changes with the sand content and the sand body of filling material qualitative properties, therefore, under the condition of less than the seismic resolution, by thin reservoir seismic attributes how to explain the relative space in thin reservoir geologic origin and reservoir space distribution is a problem. In practice, the application of seismic attribute technology widely, but their main goal is to reservoir prediction and reservoir monitoring. Almost all seismic attributes due to many reservoir characteristics, such as certain attributes some characteristics of the reservoir properties are more sensitive than the others, certain attributes can well explain the underground abnormity which is not easy to detect, all show the feasibility of seismic attributes for reservoir prediction. In the study of the past, there have been many examples, application of seismic attribute for guidance under the different geological environment and geological conditions, such as using in-depth on the basis of geological research, relying on high quality seismic acquisition, processing and interpretation, seismic attribute extraction and optimization, sand body three-dimensional carving method, application of seismic attribute technology trap identification method. In the study of prediction of oil and gas reservoir, has been applied in oilfield instance frequency division technology and coherence of seismic attribute technology to analyze reservoir prediction technology, and has obtained the certain effect.

### A. Suitability analysis, the conventional seismic amplitude attribute

The extracted seismic attributes from seismic data can reflect the characteristics of the reservoir capability parameters such as amplitude, frequency, phase, and absorbing energy, time, speed and so on. Seismic wave propagation in stratum is a very complicated process, is a comprehensive reflection of underground strata characteristics.Underground space formation properties change will inevitably cause the change of seismic reflection potter character, thus has led to the change of seismic attributes.Therefore, the capability of seismic attributes and reservoir will inevitably exist some corresponding relationship between, this also for our study of seismic attribute technology provides the basic theory of security.In geological

interpretation of the seismic attribute in petroleum exploration and development of research in the first place is the calculation process of seismic attributes (sometimes called attribute extraction), and then the analysis and use of data of attribute significance.From the geophysical meaning of seismic attributes to the geological meaning of process is the process of seismic attribute analysis, its purpose is to convert seismic attribute to and physical property, lithology, structure or reservoir parameters related information.

**B. The grey correlation properties applicability analysis**

In oil and gas exploration and development of underground structure, lithology, fault, such as knowledge mainly from seismic data, based on the seismic data processing and interpretation, outline the underground structure form and the distribution of the lithologic body.

As a result of the limitation of seismic data by the signal bandwidth, its resolution is limited, it's sometimes difficult to identify the underground geological characteristics.We in order to solve the problem of complex seismic interpretation and reservoir description, extensive use of different seismic attributes, the purpose is through the use of different seismic attributes, improve the ability of identification and describing geological phenomenon.Seismic data interpretation in the need to identify the fault and lithologic body, through the grey correlation analysis, using logging information and system matching the correlation factor analysis, choose the similarity factor as the main factor.

Grey correlation is a computing system and the correlation between various influencing factors, so as to determine the correlation between the most close to the main factors.Main mechanism is to convert numerical variable factor to geometry curve, compare the curve shape, the shape similarity degree is higher, then the greater the degree of correlation, can clear the corresponding influence factor to predict the main factor of the river.Set the drill in channel sand Wells to system sample series, series of channel sand well as negative sample.Specific process is as follows:

(1) set up the system of character sequence (based on the well known sequence) :

$$X_0 = \{x_0(1), \ldots, x_0(n)\} \quad (1)$$

In contrast the sequence:

$$X_i = \{x_i(1), \ldots, x_i(n)\} \quad (2)$$

(2) the impact factor of dimension.Due to many seismic attribute range dimension is different, lead to serious affect the prediction precision of the calculation results, therefore, the original sequence attribute dimension processing is very necessary.

$$X_i^{(k)} = X_i^{(k)} / X_i \quad (3)$$

(3) to calculate two absolute difference extremum series.Grey correlation coefficient calculation formula is:

$$\varepsilon_i^{(k)} = \frac{\min \left|X_0^{(k)} - X_i^{(k)}\right| + \rho \cdot \max \left|X_0^{(k)} - X_i^{(k)}\right|}{\left|X_0^{(k)} - X_i^{(k)}\right| + \rho \cdot \max \left|X_0^{(k)} - X_i^{(k)}\right|} \quad (4)$$

(4) calculate the correlation.Through the formula to calculate, calculate the correlation degree sequence, the correlation, the greater the instructions response channel properties of probability:

$$r(X_0, X_i) = \sum_{k=1}^{n} \varepsilon_i^k(x_0(k), x_i(k)) \quad (5)$$

Using grey correlation techniques, we can greatly improve the recognition of the geological characteristics of original seismic data, provides us with another way to raise the capacity of seismic reservoir identification.Therefore, conventional seismic and pixel processing technology and processing technology, can greatly improve the interpretability of seismic data.Using grey correlation processing techniques, we can easily hide in the strengthening and seismic data, the application of geological information extracted, and applied to the interpretation of seismic data.Because of grey correlation processing technology with the traditional seismic processing technique of complementarities, and grey correlation automatic identification and artificial interpretation of complementary, can say grey correlation technology in seismic interpretation is a very good prospect in application.

### C. The attribute fusion applicability analysis

Multiattribute RGB blend shows its essence is the use of computer image processing technology, through a linear mapping function, the three seismic attributes map to an output value. Due to its containing abundant geologic information, is a single attribute cannot be compared, in the tiny tectonic fracture, turbidite fan, river, such as geological interpretation effect is obvious.

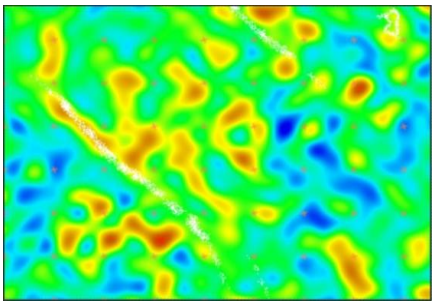
The key step is to choose to merge their properties of three seismic attributes, this requires a selection of seismic attribute contains abundant geological information, can well reflect the general trend and highlight areas.So artificial subjectively to pick up 3 ~ 4 from the sensitive seismic attributes is not associated with each other seismic attributes, an RGBA color blend, it is basically impossible. Special treatment for sensitive seismic attributes set to eliminate redundant phenomenon, can first to sensitive seismic attributes are special treatment to eliminate redundancy phenomenon. And matching on optimizing the properties of each component, the weight for each component to analysis, finally complete each attribute dimension and discrete integration, thus attribute fusion system.

## II. THE SEISMIC ATTRIBUTE OPTIMIZATION

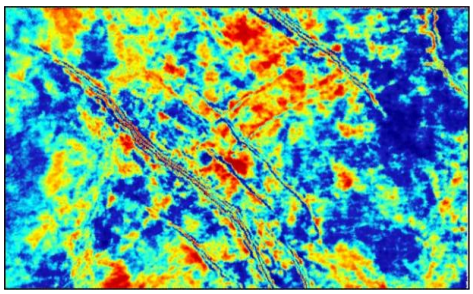
### A. The conventional amplitude attribute

In view of the destination area, first has carried on the conventional seismic attribute extraction, can be found in central area properties response is more obvious.

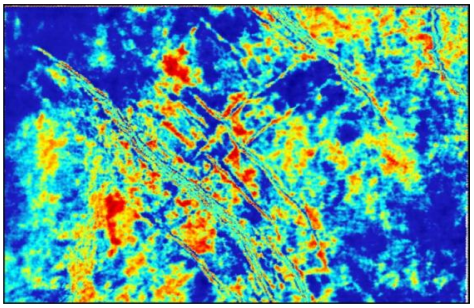
From the point of the overall effect, by targeting purposes within the layers of extract amplitude, energy, phase and other attribute as a result, can be found in central area property abnormal response is more obvious (FIG. 1-1).In the study area in northern and central parts of the anomalous areas with larger area, property plan to red or yellow areas, on both sides for the blue area, which, in SII8a unit as an example, the conventional average amplitude attribute often largest, to the south of lobules or potatoes;II8a maximum amplitude attribute anomaly area to expand, but still, in the development of the most northern east anomaly area to reduce; SII8a slope properties similar to the maximum attribute anomalous area, but the differences in the northeast, abnormal area mainly concentrated in the central and northeast, abnormal area is larger, learned, from the conventional seismic attributes and sedimentary corresponds to its precision is low, and the effective sandstone isoline conforms to the relationship is bad, so this method is not suitable for reservoir prediction in this region.



a. The average amplitude attribute



b. The maximum attribute

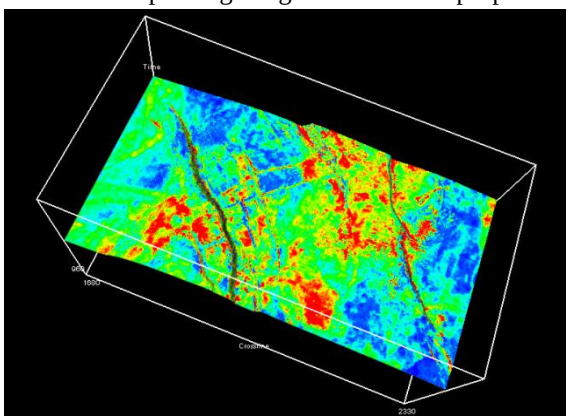


c. Root mean square properties

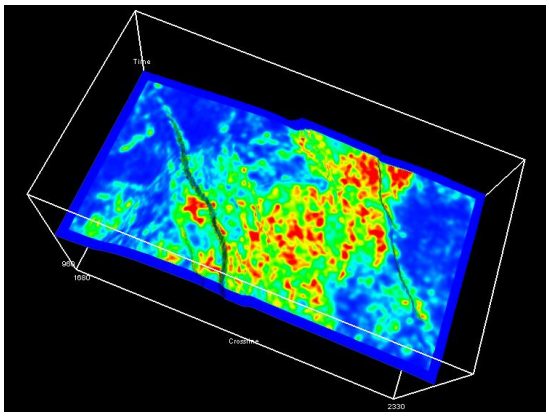
FIG. 1-1 Conventional seismic attribute extraction of II8a unit

**B. Grey correlation properties**

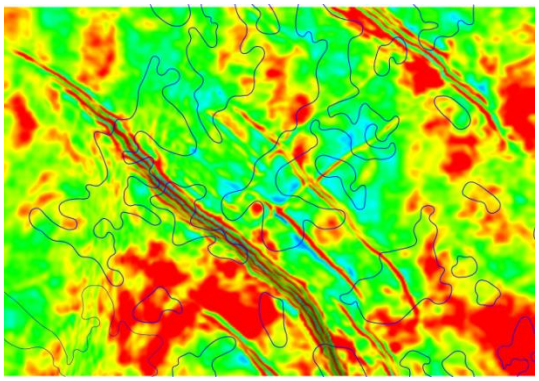
Grey correlation properties are based on image pixel processing technology, combining with seismic attributes processing technology, 3 d seismic pixel processing technology is used to describe complex geological conditions of the special geological features of properties.



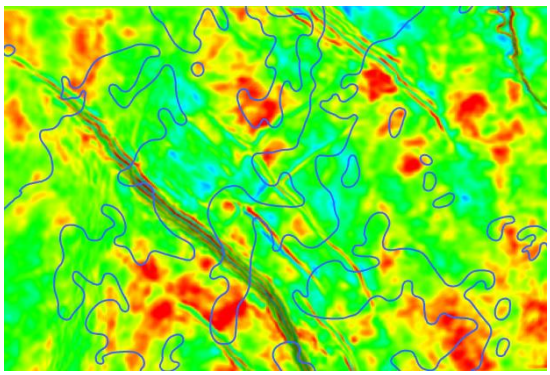
Gradient pixel attributes



Chaos pixel attributes



Continuous pixel attributes



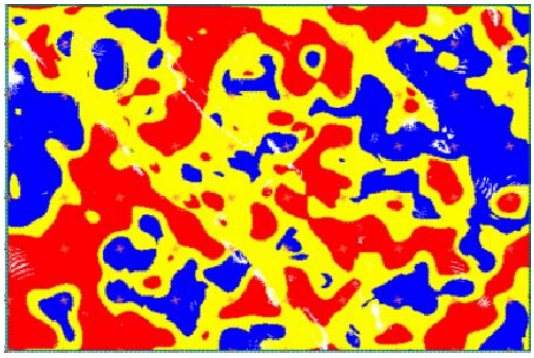
Recursive properties of pixels

FIG. 1-2 Grey correlation properties analysis of rendering

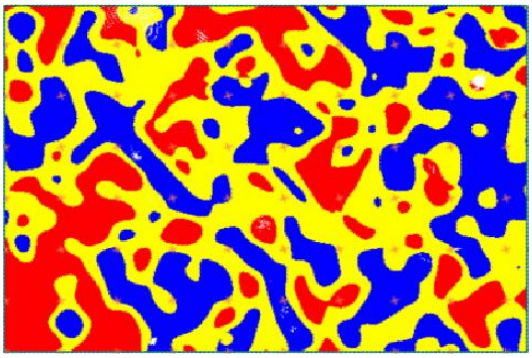
Its advantages on grey correlation property chart based on pixel attributes to determine sand body contour, but still match the deposition on the accuracy of precision is not high (FIG. 1-2), it is hard to see to the characteristics of sand body, scattered or large flower shaped sand body distribution, effective thickness and sandstone graph matching degree is poorer, unable to show the trend of river facies, difficult to adapt to the requirement of accuracy in the district.

**C. Attribute fusion analysis application**

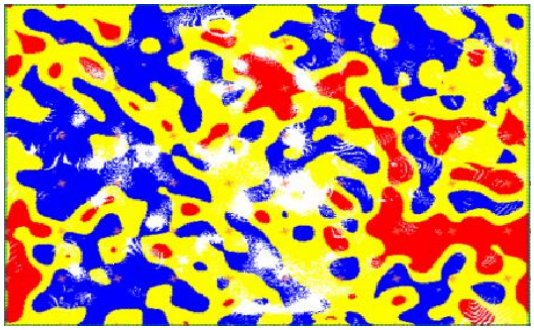
According to the results of multi-attribute comprehensive analysis above, the attribute extraction, and get the properties of the body to the original data extracted from the fusion, under control of the data obtained in the original figure attribute fusion, more accurate performance of the underground river channel sand body distribution pattern of channel phase changes and the river boundary features provide a basis and reference (FIG. 1-3).



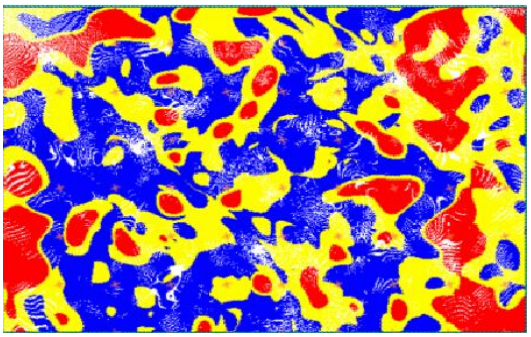
SII8a convergence properties



SII8b convergence properties



SII11a convergence properties



SII11b convergence properties

FIG. 1-3 Multiple component attribute fusion effect

Fusion properties map to see the original SII8a sedimentary phase, and the two north-south river convergence properties showed a river on the east side of connectivity is not like a good figure, sedimentary facies affected by faults is scattered distribution.SII11a purpose district of anji is also different from the original scattered distribution of the sedimentary facies sand body, but a set of connected sand body, SII12a original sedimentary facies map layer of a north-south intermittent river, middle and convergence properties are several discontinuous block sand body, in general, seismic facies attribute fusion method, for the subsequent drawing of sedimentary facies and reservoir prediction play a positive role.

According to the attributes after optimization of the fusion results, at the same time with sandstone thickness logging fitting found that attribute fusion is relatively good correlation with sandstone and, therefore, consider using attribute fusion and logging curve and thickness of sand shale fitting analysis, concrete operation is as follows: first of all, the results of seismic attribute to dimension, standardizing the different domain seismic attribute; Second, by discretization of the well point attribute results establish mathematical function relationship with logging lithology data fitting (FIG. 1-4), and analysis of the correlation of fitting; Finally, by using the function to establish complete transformation, the formation of sandstone thickness and sandstone thickness and the effective thickness of the converted for precision analysis and correction, finally complete the seismic attributes reservoir prediction graph .

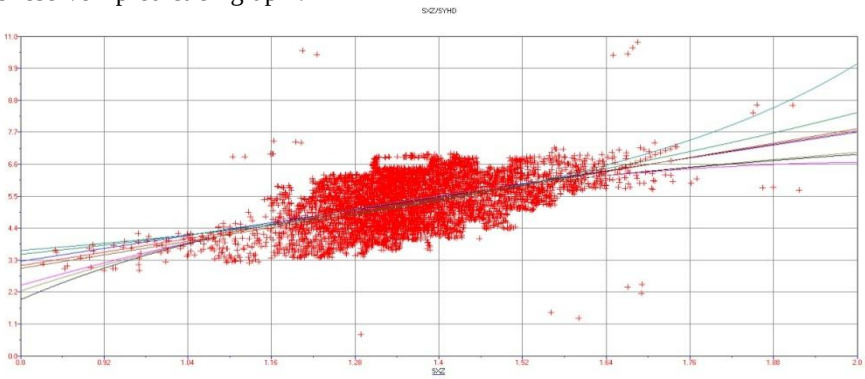


FIG. 1-4 Seismic attributes and sandstone thickness linear fitting

## III. CONCLUSION

Amplitude and grey attribute can roughly determine sand body contour, the local effect is good, but the overall accuracy is not high, reflect regularity is not obvious and is not adapted to the requirements of reservoir prediction.

Attribute fusion analysis applies to the seismic attribute in the reservoir prediction research.

Attribute fusion analysis is mainly suitable for proximal delta front such as continuous, the channel is a big body.

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