Research on seismic attribute technology

Shuming Li [1, a], Yunfeng Zhang [1, b], Guohui Qu [2, c]

[1]Department of Geosciences, Northeast Petroleum University, Daqing, China

[2]College of Petroleum Engineering, Northeast Petroleum University

[a]593999296@qq.com,[b]yunfeng4510@163.com,[c]quguohui1001@126.com

Abstract

In recent years, the seismic attributes analysis technology in lithologic interpretation, structural interpretation, reservoir evaluation, reservoir description and reservoir fluid dynamic detection has been widely used, and it plays a more and more important role in oil and gas exploration and development. Seismic attribute technology can extract the hidden useful information in seismic data and improve the accuracy of prediction of favorable reservoir zone. Therefore, the research on the application of seismic attribute technology in reservoir prediction is very important. In this paper, the application of the development process of seismic attribute, seismic attribute, seismic attribute analysis.

Keywords

Seismic attributes, lithological interpretation, reservoir description.

1. Development process

The seismic data body attribute is a kind of attribute which is extracted from the seismic data body or the other data generated by the seismic data body. The interpretation of these properties can obtain many important characteristic information about formation, fault, fracture, lithology and facies. Seismic attributes of the development of the direct hydrocarbon detection highlights from the last century 60's began, has experienced 70 years of instantaneous attribute analysis, 80's multi attribute analysis, 90's multi-dimensional attribute analysis and so on. The seismic attribute technology has been widely used in seismic structure interpretation, stratigraphic analysis, reservoir description and reservoir dynamic detection fields, the seismic attributes in oil and gas exploration and development play won the role is also growing.

2. Classification of seismic attributes

Starting from the basic definition of seismic attributes, the seismic attributes are divided into 4 categories: time, amplitude, frequency and attenuation properties of the 66 types. Temporal attributes provide structural information; amplitude attributes may provide formation and reservoir information; frequency attributes may provide reservoir information; absorption attenuation properties may provide information such as permeability and fluid.

3. Basic process of multi attribute comprehensive analysis

Conventional seismic attribute analysis and prediction mainly include target horizon interpretation, attribute extraction, quantitative prediction of reservoir parameters, and analysis and evaluation of favorable blocks. And for the development of reservoir description and prediction of seismic multi-attribute comprehensive analysis of the basic flow should be: assessment of seismic data, target

horizon interpretation, attribute extraction pre processing, attribute sensitivity analysis, attribute optimization analysis, reservoir parameter prediction and the analysis and evaluation of the (Figure 1).
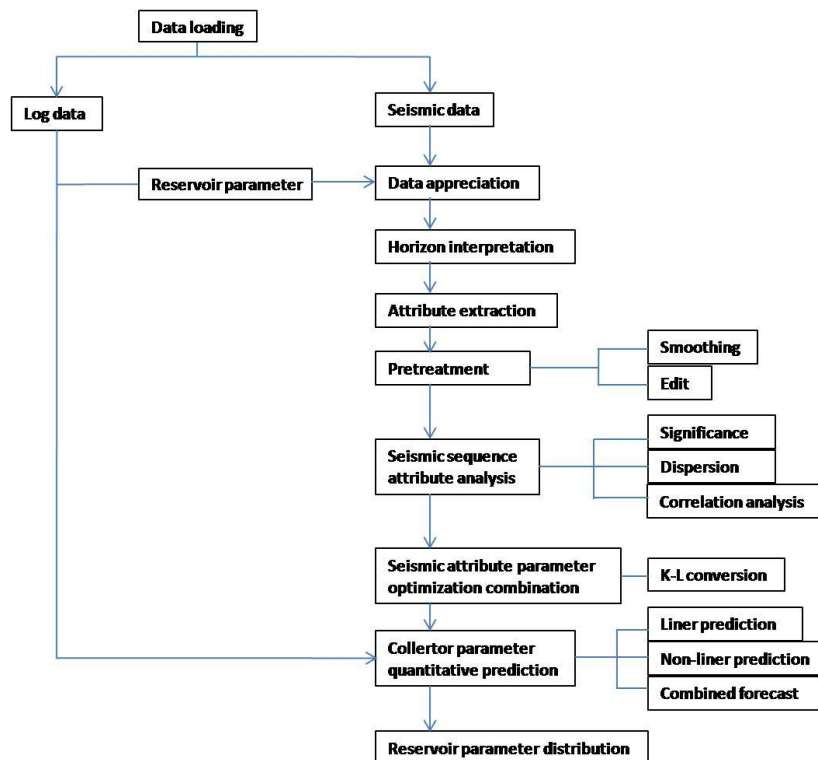

Figure.1.Basic process of multi attribute comprehensive analysis

1) Data evaluation. Analysis and extraction of seismic data in many aspects of information, combined with well logging, geology and oil production and other data on the reservoir section of the well for a comprehensive analysis, the reliability of seismic data and the reservoir physical parameters.

2) Layer interpretation. To ensure the reliability of target horizon relates to the target horizon calibration and tracking interpretation, horizon calibration of accurate and had great influence on the back layer attribute extraction, so in horizon calibration must be referenced to horizon calibration logging curve.

3) The selection of time window. There are many methods to choose the time window, and the property should be extracted from the bottom of the reservoir in order to ensure the consistency between the information of the seismic attributes and the reservoir characteristic parameters of the statistics of well logging data.

4) Seismic attribute pretreatment. The first is the standardization of seismic attribute data, so that different attributes have the same variation range, so that it can be In the following processing, it is very good, and the second is to remove the abnormal data and smooth filter. Now the usual practice is to filter processing, but sometimes can not get rid of the filter to remove the abnormal data, it must first cut the abnormal data, and then reference to the surrounding data to fill. The use of filtering to remove the remaining abnormal data, so that the seismic data as much as possible to carry the useful information of the predicted object.

5) Attribute sensitivity analysis chart. Mainly from the relative to the effectiveness of a certain reservoir average physical parameters, coincidence rate and correlation and so on of seismic attribute of comprehensive evaluation, and nearby wells reservoir parameter statistics in accordance with the principle of weighted average to. In after the completion of the statistics of reservoir parameter distribution of, choose from some statistical properties. Then, combined with the sedimentary characteristics, forward model research results to eliminate some low correlation properties, and ultimately determine the preferred attributes.

6) Optimization of the combination of attributes. Firstly, the use of empirical or mathematical methods, the most sensitive to the problem of solving the problem of the least number of seismic attributes combination, to improve the accuracy of seismic reservoir prediction. Then using K-L transform to the optimized seismic attributes dimensionality reduction mapping, eliminate some perfectly correlated and redundant attributes, reduce property in reservoir prediction in the need to build the spatial dimension, to reduce the amount of computation and improve the speed and accuracy of pattern recognition.

4. Application of seismic attributes

Sandstone rich environment usually show a strong amplitude and mudstone more environmental amplitude value general lower, due to the seismic amplitude with reasonable accuracy shows that the lithologic characteristics, so through the variation of the amplitude can infer the sand shale ratio changes.

As Figure 2 are root mean square amplitude attribute slices, yellow represents high value, blue represents low value, middle white to zero, 1189ms-1165ms period in Northwest and southeast direction of the color becomes yellow, sandstone in the two directions of content is more and more high that the two directions of sediment supply, and this time the supply continued to increase.
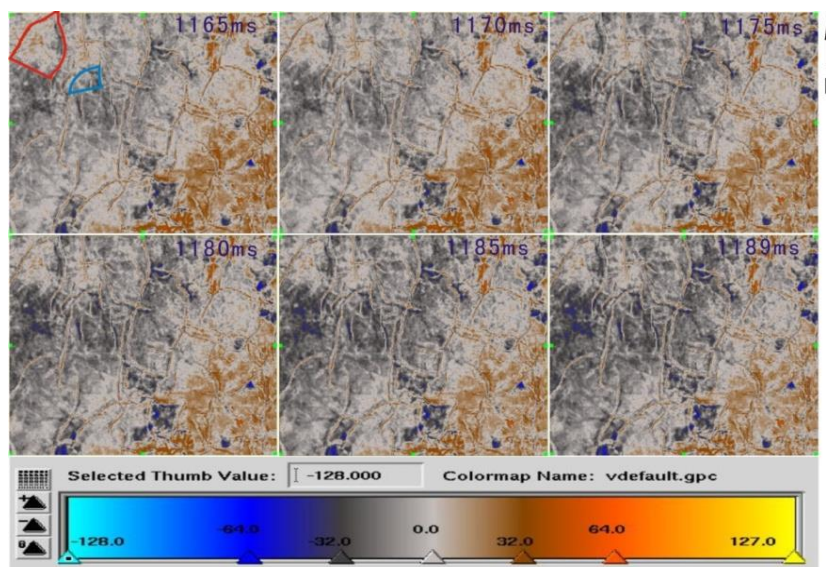

Figure.2.Root mean square amplitude attribute slices

5. Concluding remarks

Seismic attribute extraction and application to a large extent dependent on the quality of original seismic data, the extraction method of choice to according to the research goal, not only make full use of the seismic data acquired in the body, and broadened the ideas of researchers, more comprehensive anatomy of geologic targets. With the development of the mature technology of 3D visualization and virtual reality technology, the research and application of seismic attribute will have a big leap.

Acknowledgment

References

[1] Chen Q,Sidney S. Seismic attribute technology for reservoir forecasting and monitoring[J]. The leading Edge, 1997, 16(5) : 2202231.

[2] Michelena R J. Similarity analysis: A new tool to summarize attribute information [J]. The Leading

Edge, 1998, 17 (4) :62267.

[3] Marfurt K J , Kirlin R L , Farmer S L,et al. 3D seismic attributes using a semblance2based coherency algorithm [J].Geophysics, 1998, 63 (4):115021165.

[4] Gersztenkorn A , Marfurt K J. Eigenst ructure2based coherence computations as an aid to 3D structural and stratigraphic mapping[J]. Geophysics, 1999, 64(5) : 146821479.

[5] Barnes A E1Seismic attributes past , present , and future.Expanded Abstracts of 69th Annual Internat SEG Mtg , 1999,892-895.

[6] BROWN A R. Seismic attributes and their classification[J].The leading edge ,1996 ,15 (10).

[7] Sheriff, R. E.,1993, The status and advances in reservoir geophysics [J], 63rd Ann. International, Mtg: Soc. of Expl. Geophysics.,1209. (Recent Advances and theRoad Ahead)

[8] Sheriff, R. E. and Fellow, H. W.,1993, the Role of Reservoir Geophysics[J],Preview, No. 43, 11-12.

[9] Dillon, L. D.,Bastos, A.D.C.,Schwedersky, G. and Sobrinho, A. A.,1998,Dispersion effects and their impact on reservoir geophysics: A Brazilian turbidities field example [J], 68th Ann. International. Mtg: Soc. of Expl.Geophysics, 972-975.

[10] Pennington, W.D.,1997, Seismic Petrophysics: An applied science for reservoir geophysics [J], The Leading Edge, 16, No.03, 241-244.

[11] French,W.S., 2005, Distinguished Achievement Award for Curtis Reservoir Geophysics Consortium [J], The Leading Edge, 24, No.02, 198-199.

[12] Middleton, M.F., Winkles, D. and Bick, M.,2000, Magnetic signatures produced by fluid flow in porous sediments[J], 14th Geophysical Conference, Australia. Soc.of Expl. Geophysics.,31, 413-417.

[13] Pennington, W.,2001, Reservoir geophysics [J], Geophysics, Soc. of Expl.Geophysics, 66, 25-30.

[14] Johann, P.,1999, Reservoir geophysics in deep and ultradeep water in the Cameos Basin [J], The Leading Edge, 18, No. 7, 819-822.