The concept and research methods of seismic sedimentology

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Abstract

Seismic sedimentology is a new discipline by using seismic data of sedimentary rocks and their forming processes. Seismic sedimentology using 3D seismic information and modern geophysical technology for the sedimentary system, sedimentary phase plane distribution and depositional history research, It emphasizes in high precision comparative sequence stratigraphic framework based on using lateral resolution of seismic data, seismic processing technology, combined with the key well lithologic data and different genetic types of sand body morphology, restoration of sedimentary rock types and sedimentary evolution history.

Keywords

Seismic sedimentology, 90 degree phase, Stratigraphic section.

1. The background of seismic sedimentology

Seismic sedimentology is a new discipline based on seismic reservoir prediction technology, sedimentology, sequence stratigraphy, seismic For the exploration and development of the thin and thin mutual reservoir in china, the analysis of the sequence stratigraphy is coarse, and the sedimentary facies analysis is mainly on the artificial interpretation of seismic facies, which cannot solve the problem of the plane sedimentary analysis of the local area and the high frequency sequence and the prediction of the target sand body. Seismic sedimentology rely on well seismic combination, the comprehensive application of seismic attributes and inversion, it is possible to carry out four to five grade sequence of sedimentary micro phase distribution . It should be said that the emergence of seismic sedimentology adapt to the practical needs of lithologic stratigraphic reservoir exploration and development.

2. The concept of seismic sedimentology

Early day Seismic sedimentology is defined as: use of seismic data to study the formation of sedimentary rocks and the formation of a discipline. Then some scholars believe that should set up a branch in the field of sedimentology, namely---Seismic Sedimentology, which is a subject that identifies the three-dimensional geometry, internal structure, and deposition processes of a deposition cell. From these concepts can be seen, seismic sedimentology is in seismic data successfully applied on stratigraphic frame mainland layer sedimentary facies , it is the application of seismic data in the study of sedimentology and reservoir analysis of the inevitable result of the quantitative requirements. Therefore, seismic sedimentology can be defined as: high precision 3D seismic data based, with fine sedimentology model as a guide, through the comprehensive application of geophysical techniques and methods, in stratigraphic framework of sedimentary system distribution characteristics and evolution of a discipline(Figure 1).

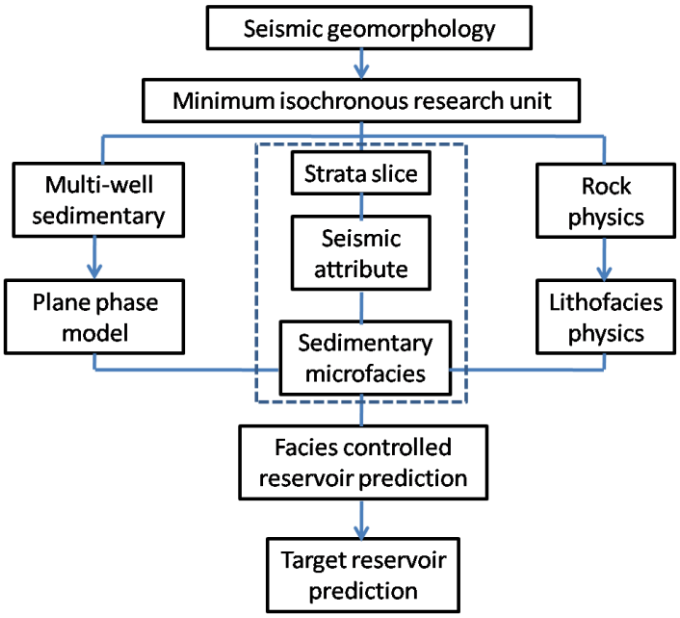

Figure.1. Research method of seismic sedimentology

3. The main research method of seismic sedimentology

3.1 90 degree phase adjustment technique

Wavelet zero phase processing is generally performed in conventional seismic processing. The zero phase seismic data are used as the advantages of seismic interpretation, including wavelet symmetry, maximum amplitude and reflection interface, high resolution and so on. However, only when the seismic reflection comes from a single interface, the above mentioned advantages of zero phase seismic data can be found. However, zero phase seismic data in the wave crest and trough corresponding to the stratigraphic and lithologic strati graphic interface does not exist certain corresponding relationship, to establish a link between the seismic data and well logging curves are very difficult. And in the actual data, especially in continental sedimentary data. The reservoir is often thin, poor continuity, narrow facies belt, and spatial variation large. For the thin layer, reflection amplitude is combination of earthquake response, it mixed with the thin top and bottom reflection, between the sand body and the seismic phase axis no direct correspondence from, so zero phase seismic data is not suitable for in the interpretation of thin sand body. Seismic profiles using 90 degree phase adjustment of the maximum amplitude of the seismic reflection wave mentioned thin center, can overcome the lack of the data of zero phase wavelet, so that seismic reflection of main phase axis will and geological thin sand layer corresponding to the center of the, seismic phase has rock Stratigraphic Significance (Figure 2).

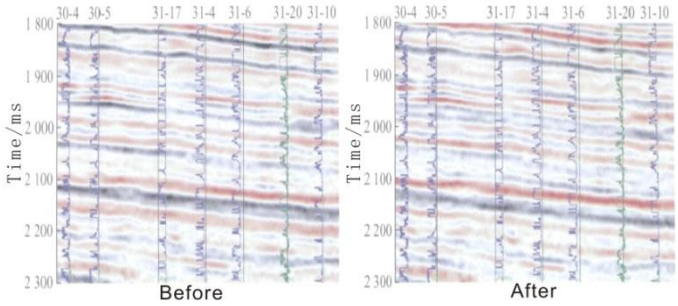

Figure.2. phase shift

3.2 Stratigraphic section technique

Usually the slice method is time slice and slice along slice. The time slice is a slice display of seismic data body along a fixed seismic travel time (Figure 3), the slice direction along the direction perpendicular to the time axis, and this method is applicable to sheet and horizontal strata; Along the slice is along a no

pole change of reflection interface, namely along or parallel to the horizon of tracking seismic phase axis income were sections (Figure 3), it is more geophysical significance. This method applicable in sheet but non flat lying strata. Actual seismic data to study with non mat shape and non flat lying strata mainly, so the application of strata slicing closer to the significance to time than the other sections. Strata slicing technique is selected two is when comparing earthquake reference phase axis, in the meantime according to the linear scale in a series of amplitude slices, slices produced by this method can easily pick up amplitude or abnormal structures of sedimentary system, it makes deposition complementary industry and trade is becoming more and more simple, and effectively solve the wear problem.

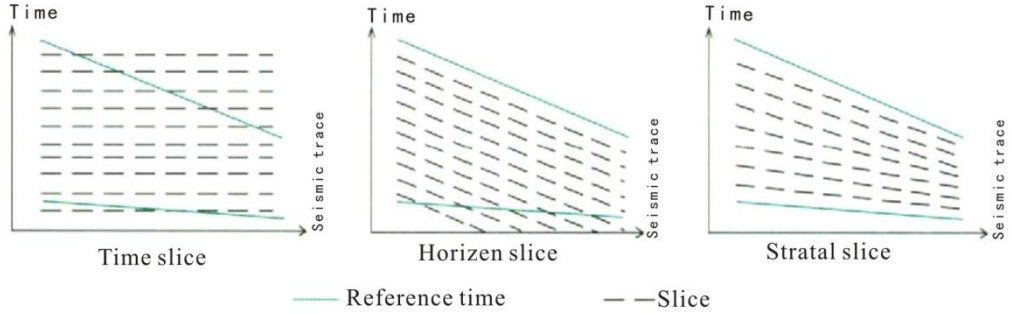

Figure.3. Stratigraphic section

4. Conclusion

(1) Seismic sedimentology with seismic measures of interwell sedimentary facies and stratigraphic lithology prediction, which represents the future direction of development; compared with seismic stratigraphy, sequence stratigraphy and sedimentology, it on the concept, research contents, research methods technology have their own characteristics. But it is not a substitute for the development of sedimentology, it emphasized the need for study of basic geology and sedimentology regularity.

(2) The 90 degree phase conversion technology has given the seismic phase to the Stratigraphic Significance, so that the relationship between Lithology Log and seismic event is more explicit.

(3) Strata slice technology is an improvement of traditional slicing technology. It takes into account the deposition rate level difference, than time slice and horizontal slice is more isochronous.

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Reference

[1] Hong liu Zeng and Milo M Backus. Interpretive advantages of 90-phase wavelets:Part 1-Modeling.Geopgysics,2005,70:7～15

[2] Hong liu Zeng and Milo M Backus. Interpretive advantages of 90-phase wavelets: Part 2-Seismic applications. Geopgysics,2005,70:17～24.

[3] Brown A R, Dahm C G, and Graebner R J. A stratigraph ic case history using three-dimensional seismic data in the Gulf of Thailand. Geophysical Prospecting, 1981,29(3):327～349

[4] Wolfgang Schlager. The future of applied sedimentary geology. Journal of Sedimentary Research,2000,70(1):2～9.

[5] Posamentier H W, Dorn G A, Cole M J, Beierle C W and Ross S P.Imaging elements of depositional systems with 3-D seismic data : A case study :Gulf Coast Section SEPM Foundation,17th Annual Research Conference, 1996.213～228.

[6] Hong liu Zeng, Tucker F.Hentz , and Lesli J. Wood, Stratal slicing of Miocene-Pliocene sediments in Vermilion Block 50-Tiger Shoal Area, offshore Louisiana. The Leading E dge,2001.4

[7] Hong liu Zeng and Milo M Backus, Kenneth T Barrow, et al .Facies Mapping from

Three-dimensional seismic data :Potential and guidelines
from a Tertiary sand stone-shale sequence model, Powerhorn Field, Calhoun County, Texas. AAPG Bullet in, 1996,80:16～46

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

[9] 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.

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

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