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Research to improve the quality of synthetic seismogram

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Abstract: - With the acceleration development of oilfield exploration and development, higher requirement for the precision of seismic interpretation is needed for that only higher accuracy of horizon calibration can match reservoir within the scope in the work area more effectively with full well to further lay a solid foundation of fine reservoir calibration which guarantee further fine structure interpretation and reservoir inversion. In this paper, some shallow understanding on how to improve the quality of synthetic seismogram is suggested including curve reconstruction, multi-resolution analysis, extract wavelet in divided time window and so on to solve problems in the practical work.

Keywords: - *Horizon calibration, Synthetic seismogram, high precision, resolution*

I. INTRODUCTION

Synthetic seismogram, the bridge connecting the seismic and geological, is the basis of structural interpretation. making Synthetic seismogram is a simplified one dimensional forward process, formula is as follows:

$$F(t) = S(t) * R(t)^{[1]}$$

S(t) represent the seismic wavelet;

R(t) represent the reflection coefficient, speed curve and density curve;

F(t) represent the synthetic seismogram made by convolution of seismic wavelet and reflection coefficient

In the practical use of landmark syntool software module to produce synthetic seismogram, all the seismic and well statistical data must be cleared up first, including the existing adjacent blocks of data, the explained seismic horizon, synthetic seismogram, layer, well curve. And then establish a landmark work area, open syntool and select a well and chose curves to make synthetic seismogram, extract seismic around the well and shows synthetic seismogram on it ,at last adjust the corresponding relation of phase axis.At this stage we have identified the rough location of the purpose layer bottom. normally we have selected a certain frequency of ricker wavelet as the wavelet debugging for making synthetic seismogram.Eventually logging curve can be compressed or stretched in order to make the event more match.But it must be within the scope of the original sound wave curve distortion so that practical geological characteristics is not killed.

II. PROBLEMS OF CONVENTIONAL SYNTHETIC SEISMOGRAM

The information needed for conventional synthetic seismogram is less, and its production process is convenient and quick, can basically meet the requirements of large scale horizon calibration.However, its precision is not enough in the increasingly sophisticated requirements of oil field development. Contrast parameters of synthetic seismogram and seismic section include reflection amplitude, waveform features, frequency and time of arrival and so on, none of them can be dispensed

with.But because of all kinds of the influence by different reasons , the synthetic seismogram and seismic section comparison cannot be completely consistent. Several layers are good, several layers are poor, makes comparison precision can't meet the needs of high resolution exploration. Problems include:

1) The precision of reflection coefficient sequence is not enough

2) The theory wavelet differences between the practical

3) Time-depth conversion speed precision is not enough

4) Log data resampling precision is not enough

5) The environmental impact and the information absence[2]

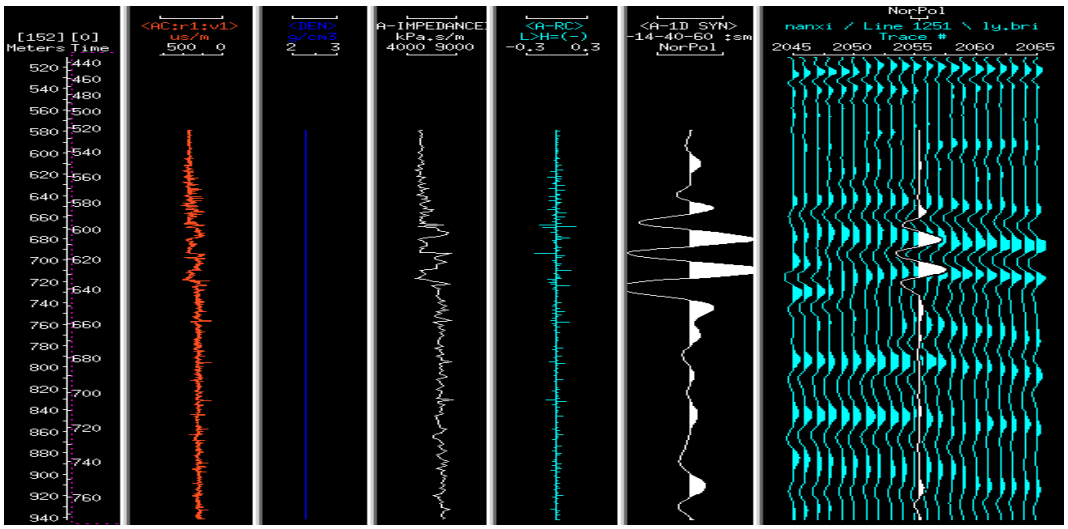

Fig 2-1 conventional seismic synthetic seismogram

III. MULTI-FACTOR COMPREHENSIVE ANALYSIS TO IMPROVE THE QUALITY OF SYNTHETIC SEISMOGRAM

The production process of synthetic seismogram is a complicated, multiple factors should be considered to make high quality synthetic seismogram, because these factors are intertwined, some even contain each other, restrict the synthetic seismogram making precision of varying degrees[3].

3.1 The combined use of density and acoustic travel time curve.

Wave impedance curve and reflection coefficient curve is closer to the practical changes of the formation using density and acoustic travel time curve combined. Synthetic seismogram calibration horizon can be seen as geological interface after introduceing density parameters, thus it is more expedient for interpreters to recognize the seismic data with geological survey correctly.

3.2 To extract wavelet in divided time window .

The seismic wavelet is time variable, the high frequency component will be absorbed by strata in the process of seismic wave transmission[4]. wavelet frequency in the seismic channel is inconsistent, in general, the more deep, the lower the frequency of seismic wave is.So it is obviously not very appropriate to extract a whole way seismic wavelet ,which causes low frequency of the seismic wavelet and the resolution will be lower using the wavelet[5].But if the wavelets are extracted on time window separately and then synthetic seismogram can not only accord with seismic profile but also improve the resolution.

3.3 The application of VSP data.

Acoustic travel time curve is vertical with depth, the seismic seismogram is time domain data. Depth domain acoustic travel time data must be converted to the corresponding time domain to compare two different domains of data,.Previous synthetic seismogram has a departure. the main reflection layer of the work area can be more accurately determined combining interval velocity measured by VSP with stratigraphic information which paly a very important role in the calibration.

3.4 The multi-resolution analysis.

Aiming at the shortcomings of the conventional logging data resampling method using in logging data resampling, the new method is proposed based on multi-resolution analysis. Compared with the conventional resampling method, It can keep the general characteristics of logging curves and better maintain the local change. At the same time, it also has a better practical effect when applying to time drift correction problem of synthetic seismogram and seismic trace matching.

3.5 Sound wave curve reconstruction.

In areas which acoustic logging data are influenced by environment seriously or have no continuous acoustic logging data, resistivity curve can be used to reconstruct a approximate difference curve by Faust formula, and then calculate wave impedance and reflection coefficient, make the synthetic seismogram.

3.6 Eliminate other effects.

Kelly bushings cannot lack and must be correct, can't use the ground elevation instead of Kelly bushing elevation. Only use the right elevation the time-depth relationship could be right, otherwise precision will be very low, or not correct at all.

Hole deviation data must be used when the deviation is big.Logging data is measured along the inclined shaft in a deviated hole, it reflects the inclined wellbore trajectory of underground conditions.

The contrast between synthetic seismogram traces and seismic traces around the well should be carried out on the basis of the same polarity.

IV. ANALYSIS OF THE PRACTICAL APPLICATION

In research of well-seismic combined reservoir accurate description at A-zone, acoustic travel time curve is usually characterized by abnormal mutation when caliper collapse in mudstone .At this time other conventional curve should be sufficient reference. According to different interval ,wavelets in divided time window extract by the seismic traces are the best choices, profile polarity and frequency must be consistent with the seismic to make precise time-depth relationship. Let the synthetic seismic waveform match with the actual seismic trace waveform precisely to make the correlation reach the highest as far as possible. Finally synthetic seismogram has a high precision and reliability after multiple integrated processes including the wavelet, density, reflection coefficient, curve reconstruction, multi-resolution analysis, velocity analysis starting from the actual data.

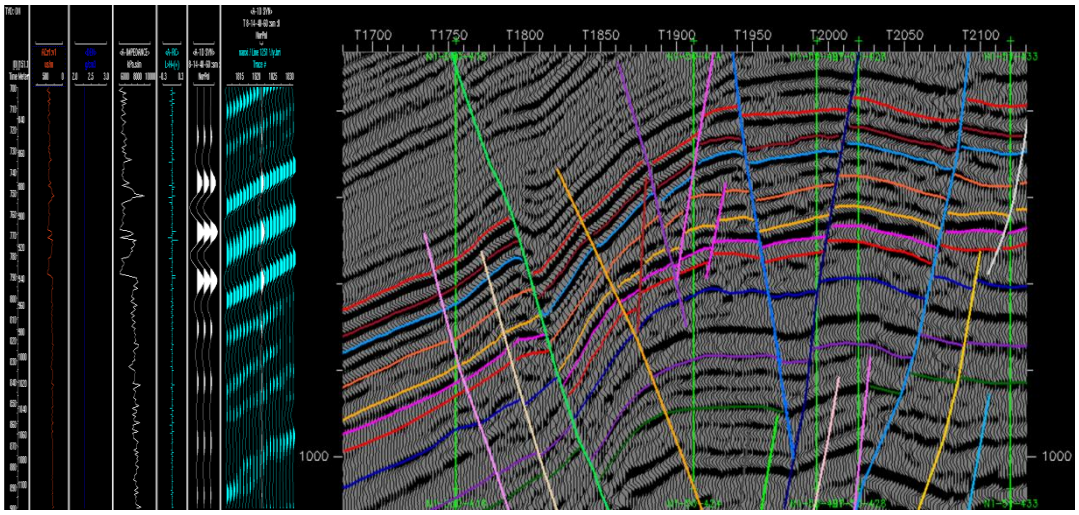

Fig 4-1 after processing high-precision synthetic seismogram guidance horizon calibration

V. CONCLUSION

Synthetic seismogram and interpretation is the foundation of seismic interpretation and reservoir description technology, is the key link of new method and the new technology of various geophysical exploration based on seismic data, especially the 3d seismic data, like structural interpretation, reservoir analysis, reservoir description. Whether suitable Synthetic seismogram can be made under the work area's seismic geological conditions and how is the precision of the production will greatly affect each link of the analysis research, we can say it is directly related to the success of each research. Fine horizon calibration is a process of repeated comparison and adjustment. It need scientific research workers integratedly use geological data, logging data, seismic data and VSP data combining with the regional tectonic characteristic, formations, sedimentary environment and so on ,uniformly calibrate strata, lithology and depth in vertical and horizontal, and finally reach the turly integration of well and seismic.

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