Q Migration and CRP Optimization Technology Based on Hessian Matrix for Unconventional Reservoir Targets Exploration

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Abstract

The tight sandy gravel reservoir target in the deep Shahezi formation in the northern Songliao basin is the key research object in the field of unconventional exploration, but the existing seismic imaging accuracy and resolution is low and the CRP gathers' quality cannot meet the requirements of pre-stack inversion. The objectives is to improve the accuracy and resolution of seismic imaging in the target area of unconventional exploration through innovation of the seismic data processing technology, so as to obtain the high resolution true amplitude CRP gathers that maintains the amplitude characteristics of AVO. We adopted the following procedures in the research: Full-frequency CMP gathers are firstly obtained through full-frequency fidelity amplitude processing, The stable phase points used to control the SNR of Q migration results were picked up from the dip gathers, and the time-space varying migration aperture was obtained by interpolation algorithm. The equivalent Q model for migration was determined and established by Q value scanning, the migration results of high resolution and high SNR and CRP gathers were obtained by the phase stabilization pre-stack time Q migration. The illumination contribution was calculated by diagonalization based on Hessian matrix, the CRP gathers was illuminated to obtain the correct amplitude relationship. Moreover, the forward results of typical well logging curves in unconventional exploration areas are used to guide to optimize the amplitude-preserving high-resolution processing for CRP after illumination compensation. Finally, the true amplitude CRP gathers satisfying the pre-stack inversion

requirements are obtained through creative application of seismic data processing techniques such as Hessian matrix. We have processed the seismic data with full coverage area of 160km^2 in Anda sag of Songliao Basin, the phase stabilization Q migration results frequency band is 16Hz wider than old ones, the ability of new seismic processing data to identify narrow channels has been improved from 150m wide to 50m wide, which can meet the requirements of fine sequence division and reservoir target exploration. Conclusion: (1) Phase stabilization pre-stack time Q migration can greatly improve the resolution and imaging accuracy of unconventional exploration targets. (2) Based on Hessian matrix diagonalization, the influence of seismic observation system irregularity on lateral amplitude relation of CRP can be eliminated and the true amplitude CRP gathers can be restored. (3) Amplitude preserving high resolution gathers optimization technology under well logging curve forward constraints can provide CRP gathers meet the requirements of pre-stack inversion. Meanwhile, the discovery and utilization of more clean energy can make a beneficial contribution to environmental protection.