

ABSTRACTS

Far-field seismic wavelet produced by point explosive source in desert. Xiao Jian-hua. OGP, 2004, 39(3): 249~252

Theoretic analysis showed that the dominant frequency of seismic wavelet in desert decreases in inverse proportion to square of spreading distance, its coefficients are related to the velocity of desert medium and the nature of source, this non-linearization leads to significant low-frequency of seismic wavelet in desert. The paper gave the formula of apparent dominant frequency of seismic wavelet in desert and pointed out that the fundamental method for increasing the dominant frequency of targets does not lie on unlimitedly increasing charge size and using dynamite with low explosive speed and lie on increasing the explosive depth of source (increasing h_0) and expanding wave front of shock wave after source explosion (increasing γ_0).

Key words seismic wavelet, seismic exploration in desert, wave equation

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3-D high-precision seismic acquisition techniques in ocean coalfield and application effects. Tan Shao-quan. OGP, 2004, 39(3): 253~258

The 3-D seismic exploration in north sea area of Beizao coalfield (belongs to Bohai sea) is the first 3-D high-precision seismic exploration aimed at offshore coalfield in China. The exploration area is 6.44 km^2 , the water depths of work area are between 0~12m, the depth of target is 809m. The geologic structural trends in work area are not consistent. There are developed faults. The goal of the exploration is to clarify the relief of faults and folds in relief of 3~5m in coalfield. Therefore, we put emphasis to use 3 measures: ① optimizing the design of geometry; ② reasonably choosing the depth of air-guns and their array pattern; ③ guaranteeing the correctly positioning of geophones. The gained high-precision seismic sections after using abovementioned measures are characteristics of evident events feature, good continuity and high S/N ratio in major targets. The errors of depth are no greater than 4m, that can basically clarify the relief of faults and folds above 5m.

Key words high precision, seismic exploration, coalfield, effect

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Several associated conceptions of depth migration. Xu Ji-xiang and Cui Hua-juan. OGP, 2004, 39(3): 259~264

The paper only analyzed the following conceptions concerning to relation between depth migration and time migration, relation between prestack depth migration and poststack depth migration, normal ray and imaging ray, ray migration and coherent inversion etc; made clear that the all migration formula are defined in depth domain, the velocities and the depths can be known as approaching to true values when the velocities of the each layer above current layer are correct and the events on common-image-gathers are aligned after updating velocity model; expounded the importance of ray migration in a process of building velocity-depth model, which can converse the layers in time domain into that in depth domain; further defined the conceptions of normal ray and imaging ray, using normal rays can converse the layers on stack time sections into the layers in depth domain and using imaging rays can converse the layers on time-migrated sections into the layers in depth domain; showed the advantages and disadvantages using coherent inversion to build the initial velocity depth model and the methods reducing the disadvantages. Only deeply understanding these conceptions can the ability of solving the problems by using depth migration method be improved.

Key words depth migration, time migration, normal ray, imaging ray

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Study of constant gradient ray-tracing method in complex medium. Xu Guang-min, Wang Hua-zhong, Fan Hua, Xin Ke-feng, Wu Guo-cheng and Chen Meng. OGP, 2004, 39(3): 265~270

Ray-tracing method is an important mean in study of seismic wave transportation. It has many algorithms, in comparison, the algorithm of Langan

et al is the best, which is not only adaptable to the models in complex mediums but also can guarantee the computational precision and efficiency. The paper deeply studied the eiconal-function-based constant gradient velocity ray-tracing method presented by Langan (1985) and made useful probe into the realization of the ray-tracing method and the application of velocity model-building in complex medium. The reflection wave, transmission wave and critical reflection are considered in the algorithm. The theoretical tests showed that the ray-tracing method has good adaptation to complex medium.

Key words complex medium, ray tracing, constant gradient velocity

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AVO weighted stack inversion of P-SV converted wave. Sun Peng-yuan, Sun Jian-guo and Lu Xiu-li. OGP, 2004, 39(3): 271~ 274

Starting from the approximation of power series of P-SV converted wave reflection coefficient, the paper gave the approximations of P-SV converted wave reflection coefficient represented by multi-composition of different parameters and explored the theory and methods using these approximations for AVO weighted stack parameters inversion. The results of the weighted stack inversion in different theoretical models showed that the larger errors existed in directly inverse velocity, density and wave impedance of P- and S-wave when using P-SV converted wave AVO for weighted stack inversion; on the contrary, direct inversion of shear modulus Δ_{\perp} and fluid factor $\Delta_{\parallel} / (\Delta_{\perp} + \Delta_{\parallel})$ not only has high precision but also has stable inverse results, being adaptable to AVO parameters inversion of P-SV converted wave and multi-wave.

Key words P-SV converted wave, weighted stack, parameter inversion, AVO analysis, reflection coefficient approximation

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Focus depth analysis for dual-parameter tomographic correction. Song Wei. OGP, 2004, 39(3): 275~ 282

The difficulty of velocity analysis in prestack migration lies on iterative update of velocity model. Based on two different velocity evaluation methods—depth focus analysis and dual-parameter to-

mographic image and through time shift, the paper uses Kirchhoff depth migration to yield depth focus analysis panel and uses tomographic imaging method on common-reflection-point (CRP) gathers to modify the velocity and depth models, that not only overcame the limits of the basic hypotheses (reflection in small angle, short offset and simple overburden) used by model-modified formula in common depth focus analysis, but also deduced a new method for seismic velocity evaluation and modification. The method gained residual moveout by focus depth analysis and CRP ray-tracing, which avoided tedious pick-up of travel-time in prestack reflection tomography. The computation results of numeric models showed that the method presented by the paper has good adaptability and processing effects in the areas having laterally rapid variation of velocity and complex overburden that common velocity analysis methods are difficult to handle.

Key words focus depth analysis, tomography, depth migration, velocity analysis, velocity model, focus analysis panel

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True-amplitude migration of wave-equation hybrid method. Liu Dong-qi, Cui Xing-fu and Zhang Guan-quan. OGP, 2004, 39(3): 283~ 286

Starting from the decomposition of wave equation extrapolation operator in 3-D non-uniform medium, the paper gained one-way wave-equation used for true amplitude migration; after a series of mathematical transformation, the paper deduced the wave fields extrapolation equations used for split-step Fourier true amplitude migration and Fourier finite-difference true amplitude migration. The paper also gave the concrete realizing process and used the numerical computed result of Marmousi model to verify the method, which showed that the method generally corresponds to common migration results but has great improvement in processed effects of some local parts.

Key words wave equation, true amplitude migration operator, split-step Fourier migration, Fourier finite-difference migration, hybrid method

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Singular inversion of multiple-bearing data. Ding Ke, Song Shou-gen. OGP, 2004, 39(3): 287~ 290

The paper discussed the capability using inverse scattering sequence to implement singular in-

terface inversion of seismic data involving multiple information. Since Born-approximate singular inverse algorithm only uses the linear item of inverse scattering sequence, that adapts itself only to the inversion of the medium having small disturbance. Using Green function theory, the paper analyzed the physical meaning of inverse scattering sequence, pointed out the wave process of inverse scattering sequence propagating to receiver points in reference medium after describing wave action on scattering points in scattering region. The results of singular inversion of multiple-bearing seismic model containing 6 layers (involving 5 reflectors) showed that the method in the paper can effectively make inversion of the position of interfaces, not only adapted to the medium having small disturbance but also adapted to the medium having large disturbance.

Key words multiple, singular inversion, Born approximation, inverse scattering sequence, disturbance

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Inversion of multi-logging parameters under constrain of relative wave impedance data volume and application. Wang Xi-wen. *OGP*, 2004, 39(3): 291~299

The paper theoretically analyzed that model-based wave impedance inversion mainly has following problems first, the experience-based build-up of wave impedance model leads multi-solution; second, the non-uniformity of goodness of fitting synthetic seismogram into seismic records near borehole resulted in modeling phenomenon. Because of this reason, the paper presented a set of methods for multi-logging parameters inversion under the constrain of relative wave impedance data volume, among which the relative wave impedance data volume is obtained by the trace-integrated algorithm. The paper also interpreted the physical meaning of trace-integrated algorithm in frequency domain—making the seismic data shift-90° of phase in effective frequency band. The paper analyzed, by real cases, the multi-logging parameters inversion methods under the constrain of relative wave impedance data volume, that proved the practice and feasibility of the methods presented.

Key words wave impedance data volume, inversion, logging parameters, oilfield development

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Study of velocity in highly steep complex area and application. He Cheng, Yuan Yong, Yu Wen-xiou, Tang Xiao-xue and Yang Fan. *OGP*, 2004, 39(3): 300~303

Taking the data in GMD area of south margin of Djungar Basin as an example, the paper expounded the building process of time-depth conversion velocity field. First, the stack velocities are edited by using Lagrangian (datum correction, elimination of anomalous values and increase and interpolation of stack velocity), then, the stack velocities are converted to root-mean-square (rms) velocities by using dip moveout and again are converted to interval velocities by Dix formula. Next, the velocity field is gained by interpolation of interval velocity sections for each line and finally using the velocity field to make time-depth conversion, that corrected the distortion of events, resulted in underground accurate structural configuration. The practical application of the method showed that the method of computing the velocity field presented in the paper is reasonable. It's worth mentioning when the interpolation of velocity field is implemented, the change of structures must be considered besides using logging data for constraint, that can gain more accurate velocity field.

Key words time-depth conversion, stack velocity, root-mean-square velocity, interval velocity

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Integrative study of carbonate reservoir in AHDAB oilfield. Ran Jian-bin, Kang Nan-Chang, Li Jian-xiong, He Feng and Cui Hong-zhi. *OGP*, 2004, 39(3): 304~309

AHDAB oilfield is in the central part of Mesopotamia foreland basin, the major oil producing zone is Cretaceous carbonate reservoirs, which are composed of 5 oil-bearing strata, among which the 4 oil-bearing strata are in Upper Cretaceous and 1 oil-bearing stratum is in Lower Cretaceous. Since 1997, the explorations have been carried out many times in the area and have resulted in 710km of 2-D seismic data and logging data in 7 boreholes, 5 oil producing zones have been found, but accurate development schedule can't be worked out because of unclear knowledge of control factors of reservoirs. Based on re-processed total 2-D seismic

data in the area by BGP, through fine structural interpretation, study of velocity fields, integrative appreciation of reservoirs from logging data, multi-well constrained inversion and finally by using the determinative minimum surface tension model-building method, the paper finished the 3-D structure models and 3-D attributes models for these 5 oil-bearing strata, proposed that the reservoir type of this area is layered edge-water complex reservoir controlled by structure and physical property of reservoir and provided 3 appraisal wells. Input of created 3-D reservoir attributes model to reservoir modeler, the dynamic modeling of reservoir can be carried out, guiding the design of the schedule of reservoir development.

Key words AHDAB oilfield, carbonate reservoir, reservoir nature

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Prediction of sand-gravel fan reservoir in Chengnan area and effects. Tan Jun-min. OGP, 2004, 39 (3): 310~ 313

There are many scale-different sand-gravel body that developed in downdropped block of Chengnan great fault. The paper used 3-D visualization technique, seismic attributes technique and coherent analysis technique to analyze and predict the time and space distribution of sand-gravel fans, used logging-constrained inversion technique and time-frequency analysis technique to describe the single sand-gravel fan and determined the space distributed feature of 6 paleo-gulches of palaeogeomorphology in the study area and their corresponding more than 10 sand-gravel bodies such as Cheng 913 etc., preliminary forming the predicting and describing series of sand-gravel body, that realized high-efficient exploration and development of sand-gravel fan reservoir and resulted in good exploration benefits.

Key words Chengnan fracture belt, sand-gravel fan, 3-D visualization, seismic attributes, coherent analysis, logging-constrained inversion, time-frequency analysis

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Predicting method of formation pressure in Jiyang Depression. Tan Ming-you. OGP, 2004, 39(3): 314~ 318

The mechanical relation built based on sedi-

mentary compaction process showed that the pore-fluid pressure P_e is related to overburden pressure P_h and effective pressure P_e , among which the P_h can be gained by the density of formation, P_e by stack velocity. It considered by the analysis of sensibility of predicted precision of formation pressure in Shandong area of Jiyang depression that the change of seismic velocity and overburden pressure gradient are sensitive to formation pressure, so that the data of interval transient time and real-measured pressure of 100 wells in Jiyang depression have been counted up and the data of seismic velocity spectrum of 1000 positions in that area have been interpreted, that basically clarified the factors caused anomaly of seismic velocity spectrum in the area and built the model of correcting the interference resulted from anomaly of seismic velocity spectrum data; the computations of models of normal formation pressure for three sags have been finished separately by logging density and average density, forming a set of predicting methods for formation pressure characterized by advanced technology, easy to operation and good practicality. Application of these methods to predict the formation pressure of 15 prospecting wells, the absolute errors between the predicted results and the formation pressure coefficient of real drilling data are less than $0.1\text{g}/\text{cm}^3$ and the maximum relative errors are less than 10%, overcoming unstable and big skip's shortcomings the former prediction of formation pressure had, which met the demands of prospecting drilling for the prediction of formation pressure.

Key words formation pressure, velocity spectrum, prospecting well, pressure gradient, Jiyang depression

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Application of DIVA technique in Ying ge Sea basin. Zhu Hong-tao, Chen Kai-yuan and Zhu Pei-min. OGP, 2004, 39(3): 319~ 321

DIVA (Differential Information Velocity Analysis) technique is a seismic oil/gas detection technique. In view of the character of seismic velocity of Ying ge Sea basin being generally gradual increase with the depth but locally having the phenomenon of strong velocity decreasing, the paper used the DIVA technique to detect oil and gas in Ying ge Sea basin. First, drawing out composite DIVA graphs in a principle from shallow to deep based on the velocity graphs in each layer; then

drawing out the DIV A sections from these composite graphs based on same principle; finally grading and determining the favorable oil/gas-bearing zones based on reliability of velocity anomaly showed on DIV A sections. The detection results of the region showed the DIV A anomalies mainly are I class in shallow layers and mainly are II class in medium and deep layers.

Key words Ying ge Sea basin, medium and deep layers, velocity, differential information velocity
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Using superiority of 3-D, 3-C geometry to select favorable region of anisotropic imaging. Cheng Zeng-qing, Huo Quan-ming, Peng Su-ping, Hu Chao-yuan and Gou Jing-wei. *OGP*, 2004, 39(3): 322~ 326

3-D, 3-C seismic exploration is development of common 3-D seismic exploration, it not only can be implemented in geologic structural exploration, but also can be implemented in lithologic and anisotropic medium exploration. In view of more complexity in 3-D, 3-C seismic field operation and high cost of acquisition, the optimum analysis of seismic field acquisition geometry is more important. For this reason, the paper introduced the conception of superiority analysis. The superiority is not only related to offset distribution, azimuth distribution, bin size and folds, but more important, the parameters of superiority analysis can be used for study of favorably distributed region of anisotropy in the medium.

Key words 3-D, 3-C, superiority, anisotropy, imaging, favorable region

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Application of 3-D prestack depth migration in Haila'er area. Liu Zhen-kuan, Wu Qing-ling, Wu Ming-hua, Chen Zhi-de, Bi Min and Yu Qin-fan. *OGP*, 2004, 39(3): 327~ 331

The paper used prestack fine pre-processing, 3-D residual velocity analysis, Monte Carlo automatic velocity pick and 3-D Kirchhoff depth migration to carry out prestack depth migration processing of 3-D seismic data in Haila'er area. In comparison with ordinary poststack time migration, the results are characteristics of clear imaging of faults in shallow and medium beds, development of fault plane reflection, considerable improvement of basement imaging, distinct deep reflection structure and

clear contact relation between the layers, which laid a solid foundation for further oil/gas exploration in the region.

Key words prestack depth migration, residual velocity analysis, Monte Carlo automatic velocity pick, seismic imaging

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Proni filtering technique and its application in oil/gas prediction. Liu Shu-hui and Xu Ren. *OGP*, 2004, 39(3): 332~ 337

In view of higher resolution of Proni transform in time domain or frequency domain and providing attenuation parameters related to oil/gas at the same time, combining with synthetic seismogram of theoretical models, the paper discussed the noise-suppressed feature and stability of Proni filtering on the basis of the results studied by our predecessors and applied the Proni filtering to oil/gas prediction of field seismic data. There are three filtering parameters that are very important, that is pulse length $\Delta\tau$, band width $\Delta\omega$ and attenuation factor $\Delta\alpha$, the optimum values of which are determined by experiments. The results of practical application showed that the Proni filtering is sensitive to attenuation by absorption of seismic wave in high frequency, by which the prediction of oil-bearing probability of bed can be effectively implemented, the successful rate of prediction is about 70%.

Key words Proni transform, oil-bearing property, prediction, signal decomposition

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Adaptability of wavelet analysis in MT noise-suppressed processing. Liu Hong, He Lan-fang, Wang Xu-ben, He Zhan-xiang and Wang Jiao. *OGP*, 2004, 39(3): 338~ 341

On the basis of analyzing the MT technical characters in oil exploration and its existed problems, the paper analyzed the adaptability of using wavelet analysis for MT noise-suppressed issue. It is unable to gain correct results only using common processing measures currently we have when the coherent noises and other strong noises existed in MT time series, but using the self-adaptability and localization of wavelet analysis method can carry out the noise-suppressed analysis of MT time series, at this time, the every error between reconstructed time series and original time series in

wavelet analysis should be less than 0.05%. This studied result provided the foundation for application of wavelet analysis to MT noise-suppressed analysis and a feasible way for noise-suppressed processing of MT time series.

Key words MT, wavelet analysis, noise-suppressed processing, adaptability

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Study on electric azimuth anisotropy of controlled source in frequency domain and near-field effects.

Yue Rui-yong and Xu Yi-xian. *OGP*, 2004, 39(3): 342~347

There are the issues of how to divide the near-field from the far-fields when using manual field source for electro-magnetic prospecting. Taking the azimuth-anisotropic and half-infinite earth as a model, the paper yielded the far-field distance (FFD) of ground horizontal electric dipole (HED) by computation, presented taking relative variation $\leq 5\%$ as the judge condition of dividing the near-field from the far-field. The influence of azimuth-anisotropy on division of the near-field from the far-field has been studied by numeric tests, that resulted in following conclusions the linear relation between the far-field distance (FFD) and skin effect existed when the anisotropic parameters are certain; the affect of anisotropy on FFD in formation strike is larger than that in its orthonormal direction, the same is true for its value.

Key words azimuth anisotropy, horizontal electric dipole, magnetotelluric, far-field

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Structural and depositional feature of beach area in Bohai Bay and favorable exploration zones. Zhao Xian-zheng, Zheng Liang-he, Li Ting-hui, Fan Zhe-qing and Hu Yong-jun. *OGP*, 2004, 39(3): 348~353

The areas of Bohai Bay beach are about 17000km², it is the area having large exploration potential. The area is controlled by two groups of deep and large faults and has a structural transitional belt on coast. It is proved that the transitional belt and its both sides are rich oil/gas-bearing zones. In Dagang-Jidong beach area, E-W structures are mainly controlled by transitional belt, the depositional feature are mainly controlled by the material sources from Yanshan fold belt, Chengn-

ing swell and Cangzhou swell. On the basis of integrated considering of structural feature, depositional characters and petroleum-geologic conditions, the paper made integrative appraisal of II grade of structural belt in Dagang-Jidong beach area and optimized 3 favorable exploration zones such as Chengbei fault bench etc.

Key words Bohai Bay basin, beach area, structural feature, depositional character, favorable zone

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3-D Poststack project time migration—discussion about migration aperture with Mr. Mu Yong-guang. Wu lu. *OGP*, 2004, 39(3): 359~365

Seismic migration imaging is an important component to seismic data processing. The author and his colleagues have devoted to study project migration imaging since 1994, which includes 3-D (2-D) pre-stack (post-stack) depth (time) domain project migration etc. In this paper we mainly describe the principle and implementation method for post-stack 3-D project time migration. The proposed method is on the basis of famous Fourier projection theorem. After processing of 3-D seismic data volume by making horizontal time slice along time axis and Radon projection, we obtained a series of 2-D radial sections. Using Radon interpolation and then reverse projection for these sections, the purpose of 3-D migration finally can be achieved. Compared with one-pass migration method, the project migration showed a result having improvement in ratio of signal to noise for all sections, obviously improving the continuity of events and the accuracy of imaging in local area.

This paper also discussed about the migration aperture in seismic data processing. The application of some methods, such as project migration method with complete observation angle based on tomography theory and pre-stack migration method with double-square-root operator in source-offset domain, needs not select migration aperture. Author points out that such point of view as “there is necessary to consider the effect of migration aperture in all migration method.” is not correct, and moreover, this opinion is not of benefit to developing of migration method in the future.

Key words seismic migration, project migration, migration aperture, Radon transform, radial section