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ABSTRACTS

Study on acquisition methods without geophone array by numeric modeling of 3D seismic wavefield

Pei Zheng-lin, Wang Shang-xu, Di Bang-rang and Song Wei OGP, 2005, 40 (2): 138~ 142

Using traditional geophone array technique for seismic acquisition leads to unsuccessful results in some complicated mountain areas of west China. Is it possible yet to use non-geophone-array for seismic acquisition? The paper uses staggering grid high-order limit-difference method of 3D first-order scalar pressure-velocity wave-equation in non-homogeneous medium for 3D acoustic simulation of sin mountainous model, and different array in-door and stack processing is carried out for the modeling records, the results show that the method not only can flexibly and conveniently finish geophone array aimed at effectively suppressing interference, but also can obtain optimum stack sections. It is possible that the seismic acquisition technique without geophone array can be an effective way to solve the problem of seismic acquisition in complicated mountain areas.

Key words: receiving without geophone array, mountainous area, 3D scalar wave-equation, staggering grid, limit-difference

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Impact of preliminary model on CFP imaging technique **Liu Jiang-ping and Yao Yao** OGP, 2005, 40 (2): 143~ 148, 157

CFP imaging technique is an imaging technique having excellent theoretical characters, which is not concerned in modification of velocity field and only the focus operator is renewed. The migration process is driven by one operator, and fulfillment of prestack migration is finished by two continuous focus steps that are independent each other. The basis of CFP imaging technique is move-out, and the keys are pickup of time-shift and renew of focus operator. The selection of the preliminary model tends to have influence on pickup of time-shift and renew of focus operator, so that needs to study the preliminary model-building principle and influence of preliminary model on renewing focus operator. For that reason, the numer-

ic modeling of DTS templates and operator-renewing processes having different preliminary models and characteristic points is carried out for three-horizontal-layered model with uneven terrain. The results show that the positions of focus-points-related horizons being in templates and on CMP gathers and slopes of events change with preliminary models, and the change of t_0 time of model is more sensitive than the change of the velocity; the influence of the increase of model velocity and the decrease of model time on DTS template and renewing focus operator has similar rule and feature; the variation of preliminary model not only affects the correct pickup of time shifts of corresponding horizons in DTS templates, but also leads to horizon skip when picking up time shifts in DTS template. The renewing of focus operator mainly depends on the first renewing.

Key words: CFP imaging, preliminary model, DTS template, focus operator

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Differential forward modeling of wave equation having irregular grid and any-order precision **Zhu Sheng-wang and Wei Xiu-cheng** OGP, 2005, 40 (2): 149~ 153

The finite difference algorithm is usually used in forward modeling of wave equation, and its calculating precision depends on used discrete grid and differential order. Using regular grid for discretization results in diffraction noise for dip interface, and infilling grid may increase the computing efforts. For that reason, the paper presented a differential forward modeling method by using irregular grid and having any order precision, which can basically eliminate discrete diffraction noise and improve forward modeling precision in a precondition of slightly increasing computing efforts. The tests of two models showed that the method can better overcome discrete diffraction noise resulted from numeric discretization on dip interface and is an effective and practical method for increasing forward modeling precision in complicated geological model.

Key words: wave equation, seismic numeric model-

ing, forward, grid, discrete, finite difference, dispersion

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Noise-eliminated method for seismic signal based on second wavelet transform. Fu Yan. OGP, 2005, 40(2): 154~ 157

On the basis of Donoho's wavelet threshold noise-eliminated processing method, the paper presented a noise-eliminated method for seismic signal based on second wavelet transform. The multi-scale wavelet transform is carried out for seismic signal in the method, then second multi-scale wavelet transform is carried out again for wavelet coefficients in scale 1 mainly controlled by noises, zero is set for wavelet coefficient in scale 1 after second wavelet transform and reconstruction of wavelet coefficients in other scales is carried out, finally, the wavelet threshold noise-eliminated processing is carried out for seismic section after above-mentioned processing. The results of theoretical model and practical data processing showed that the method presented by the paper can effectively improve processing quality of seismic sections and S/N ratio of seismic data.

Key words: second wavelet transform, seismic signal, random noise, threshold

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Method for fine picking up seismic wavelet at up-hole trace. Zhang Guang-zhi, Liu Hong and Yin Xing-yao. OGP, 2005, 40(2): 158~ 162

How to determine the seismic wavelet at up-hole trace from seismic data and logging data is the key of wave impedance of formation at uphole trace. On the basis of detailed studying the method of determining seismic wavelet's length proposed by M. R. Rietsch, the paper presented a method for fine picking the seismic wavelet at uphole trace based on discrete inversion theory and considering spatial variation of wavelet: the amplitude spectrum of preliminary wavelet is picked up from multi-channel correlation method; phase spectrum of preliminary wavelet is determined combining with logging data; finely resolving seismic wavelet at uphole trace by iterative computation based on discrete inversion theory.

Key words: seismic wavelet, inversion, wave impedance, uphole trace

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Preliminary study of using 2D multi-level median filtering technique to eliminate random noises. Liu Cai, Wang Dian, Liu Yang, Wang Pei-mao and Li Qin-xue. OGP, 2005, 40(2): 163~ 167

2D multi-level median filtering technique is a mature technique in signal processing, which has not only auto-adapted ability, but also has changeable feature of windows. The paper uses this technique to eliminate the noises in seismic exploration, and emphasizes analysis of the relationship between the noise conditions and the length of filtering factor. The noise conditions defined by the paper include two factors: noise strength and noise distribution density. The effects of 2D multi-level median filtering are better by selecting the filtering length as 5 points when the noise conditions are fixed; changing the noise strength has no determinate role for selection of filtering length when noise density is fixed; changing noise density has significant influence on filtering length when noise strength is fixed. It is shown by practical data processing that the method not only can effectively suppress random noises, but also can reduce the shallow refraction interference in some degree.

Key words: random noise, noise strength, noise density, 2D multi-level median filtering, filtering feature

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Briefly talk about processing techniques of improving S/N ratio in seismic data processing. Yuan Yijun, Zhou Zhixu, Niu Bin-hua, Wang Huan-di and Liu Aixiang. OGP, 2005, 40(2): 168~ 171

The S/N ratio and resolution of seismic data are most basic issues of seismic data processing. The key techniques of improving S/N ratio of seismic data are as follows: suppressing noise and highlighting useful signal; making efforts to fulfill in-phase stack; better handling the relation between resolution and S/N ratio. In view of above-mentioned key techniques, the paper expounded some key techniques of improving S/N ratio processing in following aspects: arranging noises under cate-

gories, interference suppression, noise attenuation and in-phase stack etc, compared advantages and disadvantages and adaptive conditions of different noise-eliminated methods and describe the selection of used parameters in part of methods. Finally, it is shown by the cases that it should use different noise-eliminate methods when the noises are different.

Key words: S/N ratio, noise, noise elimination, parameter

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Using cross-hole seismic data and logging data for fine reservoir interpretation. Shi Zhen-fei and Yin Xing-yao OGP, 2005, 40 (2): 172~ 175

Using cross-hole seismic data and logging data for fine reservoir interpretation can provide more accurate reservoir configuration and physical data of reservoir and then improve the precision of the whole in reservoir description. The main ideals are:

collecting and integrative analyzing such data as drilling, geologic, logging, structural and reservoir dynamite and through study of the characteristics of 3D seismic data volume (geologic body) and seismic facies to create database of cross-hole seismic data; geologists carry out geological layers partition according to well profile data of two wells and draw the geological profile according to correlation principle and common profiling method; on the basis of geological research and using well column data of two wells, the development seismic researchers carry out detailed interpretation on the cross-hole seismic sections in order to gain relevant interpreted maps. According to above-mentioned ideals and through the cases, the paper carries out fine interpretation for minor cross-hole faults and internal structures of channel sand body, which better solves the difficult problems in production and provides powerful basis for fine interpretation of 3D high-precision seismic data.

Key words: logging trace, cross-hole seismic data, 3D seismic data, fine reservoir interpretation

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Compensation for spherical dispersion and absorption in time-frequency-space domain. Ling Yun, Gao Jun and Wu Lin OGP, 2005, 40 (2): 176~ 182, 189

The special variations of near-surface lithology in land seismic exploration lead to significant special changes in shooting energy and shooting wavelets, and then result in seismic reflection attributes of final imaged reservoirs. These changes are much more large than the changes in reservoir information caused by geology and oil/gas factors, leading to a difficulty for reservoir identification. Former compensation for spherical dispersion and absorption, surface-consistent amplitude compensation and surface-consistent deconvolution can eliminate certain near-surface influence in some degree, but are difficult to effectively eliminate near-surface influence in three domains: time, frequency and space. For that reason, on the basis of original method of compensation for spherical dispersion and attenuation by absorption in time-frequency domain, the paper presented the method of "Compensation for spherical dispersion and absorption in time-frequency-space domain." The method has been proved by processing, interpretation and production drilling of 3D development seismic data in real oil field that the compensation method can meet the processing demand for relative reservation of amplitude information of reservoir, while eliminating influence of near-surface on seismic attributes. Therefore, the method is effective method for compensation for near-surface and ground attenuation by absorption.

Key words: near-surface influence, ground attenuation by absorption, time-frequency-space domain, spherical dispersion and absorption, compensation for attenuation

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Studying SWD VSP technique and results of its preliminary application. Gou Lian, Yang Ju-yong, Luo Bin, Wang Bao-bin, Zhao Bo and Yan You-sheng OGP, 2005, 40 (2): 183~ 189

Comparing with ordinary VSP, the SWD VSP has its feature and distinctive superiority. It uses the noises produced by drill bit during drilling process as a source for inverse VSP survey characterized by without interference of drilling and occupation of drilling time, no risk of damaging borehole, and especially having capability of real time predicting structural details of strata ahead of bit by in-site seismic image processing. The key techniques are how to accurately acquire and restore weak seismic signal produced by bit under the

background of strong interference noises at wellsite and to transform these signals into equivalent pulse response of horizons. The paper introduced the basic principles of VSP technique and key techniques used, it is shown through analyzing the results of roller bit SWD VSP data processing in Lun-Gu 47 well and making correlation with the surface seismic section passing through the well that the acquisition and processing techniques used in paper can obtain seismic imaging section corresponding to 3D surface seismic data, having good popularized application prospect.

Key words: SWD VSP, roller bit, bit signal, pilot signal, data processing

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Seismic identification of fracture-developed zone of dense reservoir and relative strategy. He Zhen-hua, Hu Guang-min and Huang De-ji OGP, 2005, 40 (2): 190~ 195

The fractures and caves system in dense formation plays an important role in oil/gas accumulation and migration. It is difficult to use seismic data to identify and detect the fractures system in dense reservoir because of multi-scale of fracture and limitation of resolution of seismic data. In this paper, we discussed these issues and pointed out that the spatial distribution of fracture-developed zone in reservoir can be determined if proper techniques and strategy are used. The techniques used mainly include: application of 3D seismic multi-scale margin detection technique, correlation analysis of seismic numeric modeling and detection results and using multi-source information such as seismic, geologic, logging and drilling for integrative interpretation.

Key words: fracture-developed zone, 3D seismic data, multi-scale fracture margin detection, study strategy

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Application of S-wave anisotropy to evaluation of fractured carbonate reservoir. Zhao Jun, Zhang Yong-zhong, Yang Lin, Deng Ning, Li Wei-yan and He Zong-bin OGP, 2005, 40 (2): 196~ 199, 203

The fractures of carbonate reservoir are important storage space and permeable channel of oil/

gas. The evaluation of fractured effectiveness is always difficult problem in evaluation of carbonate reservoir by logging data. Starting from the anisotropy characterized by fractured strata and based on splitting phenomenon produced by transmission of S-wave in fractured strata, the paper uses the dipole S-wave imaging (DSI) logging data to detect fast and slow S-wave information and then to show the degree of anisotropy; the goals of identification of fractures and evaluation of its effectiveness are reached by the close relationship between the characters of S-wave anisotropy and density and open degree of fracture. The practical application in fractured carbonate reservoir in Lunnan region of Tarim basin proved that using S-wave anisotropy character can qualitatively analyze the fractures and provide an effective technique tool for looking for oil/gas wells with high and stable production and for testing decision.

Key words: reservoir evaluation, carbonate, S-wave, anisotropy, fracture

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Correction of 3D shot-points offsets in Xinlongtai urban district. Cai Jia-ming, Liu Yong-hong, Cao Mong-qian and Wang Qiang OGP, 2005, 40 (2): 200~ 203

When 3D seismic exploration is carried out in urban districts, if designed shot-points are near the buildings, the safety problem of buildings always exists in some degree whether using dynamite source or vibroseis. Therefore, there is often deviation of the positions of some designed shot-points in geometry from the practically used positions in field production, which brings a lot of troubles in seismic data processing. In order to solve this problem, the paper presented using synthetic regional first break time-distance template of shot records for correction of shot-points offset faced with the character of more stable near-surface velocity in the east of China. The method first draws first break travel-times of some normal shot and receiver points (coordinate positions of shot and receiver coincide with recorded positions in log book of field production) as synthetic regional offsets-first break travel-times template, then uses the numeric relationship between offsets and first break travel-times to look for real positions of shot-points offsets, which reaches the goal of correction of shot-

points offsets. The results of practical seismic data processing showed that the method can accurately finish the correction of total shot-points offsets on its first operation and has popular adaptability for the correction of shot-points offsets in land seismic exploration of the east of China.

Key words: 3D seismic exploration in urban districts, shot-point offset, synthetic time-distance curves template, offset, first break travel-time

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Prediction of physical reservoir parameters by seismic attributes pattern cluster. **Chen Bo, Hu Shao-hua and Bi Jian-jun.** OGP, 2005, 40(2): 204~ 208

Seismic pattern cluster prediction technique is a pattern recognition technique, which has wide application in the prediction of oil/gas reservoir. The key of successful application lies as follows: the quality of seismic data used meet the needs of high S/N ratio, high resolution and high fitting; building up correct geological model (integrative framework) so that can provide good study sample for neural network training; selecting neural network with multi-layer sensor. In above-mentioned second link, in concern with formation-partitioning of reservoir it must make effort to refine according to lithology characters, then correctly label the seismic information according to layer-refined data by logging data and build up the link between seismic attributes information and geologic and drilling information. The paper listed the applied cases of two oilfields and further proved application effects of the method.

Key words: seismic attributes, integrative framework, neural network, modeling logging

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Application of fine reservoir prediction technique to oilfield development **Wang Xi-wen.** OGP, 2005, 40(2): 209~ 218

Aimed at the problems existed in reservoir prediction during oilfield development, the paper summed up a set of ideas suitable for fine reservoir prediction in complex geologic conditions of China and available techniques that mainly include the following aspects: fine structural interpretation techniques; logging-data-based sedimentary micro-facies model-building techniques; logging data correction and normalization processing tech-

niques; techniques of studying logging response of reservoir; techniques of high-precision inversion of reservoir; computation of reserve and well-site deployment etc. The total process is both independent and uniform iterative studying process. The paper presented facies-controlled-isochronal mini-strata correlation method in view of the problems existed in mini-strata correlation and logging-data-based sedimentary micro-facies model-building technique, which can improve the precision of mini-strata correlation. Finally, the method was used for the prediction of Dagang Bannan well-site 4-2 oilfield and good results are gained.

Key words: oilfield development, fine reservoir prediction, vertical resolution, Bannan well-site 4-2 oilfield

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3D refraction static corrections in complex regions and its applied effects **Yang Hai-shen, Jiang Xian-yi, Gao Yan-lin and Wang Lin-guo.** OGP, 2005, 40(2): 219~ 225

3D refraction static corrections technique is a complete set of techniques, which is concerned with such steps as pickup of first breaks of refractions on seismic records, strata partitioning of refractors, analyzing refraction velocity, computation of time delay, building up near-surface model and computing datum statics. In order to improving the final effects of static corrections, strict QC for above-mentioned links is needed. It should ensure that the times of first breaks of most traces are correct while picking up times of refracted first breaks, that can ensure the subsequent processing to meet the demand. Because the times of refracted first breaks on the seismic records are characteristics of continuity and high folds, increasing statistical effects, the near-surface models building up therefor are more practical and computed statics are more correct. 3D refraction static corrections are suitable for such complex surface conditions as mountains, transient zones, loess plateaus, hills, which have more severe static corrections problem.

Key words: 3D refraction static corrections, velocity analysis, delay time, quality control

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Standard of logging data in constrained seismic inversion and fine labeling of reservoir Meng En, Xu Gang, Shen Cai-yu and Wang Hui OGP, 2005, 40 (2): 226~ 232

Whether the constrained seismic inversion is correct and accurate that depends on basic work in a great degree. Standard processing of logging data and fine labeling of reservoir are the kernels of basic works of constrained seismic inversion. It is shown by the practical cases in the paper the influence of logging data that has been processed by standard edit or has not been processed by standard edit on inversion results, the former resulted in accurate labeling of reservoir and the later has poor results. The paper briefly introduced the methods for standard edit processing of logging data in constrained seismic inversion and fine labeling of reservoir.

Key words: standard of logging data, fine labeling of reservoir, constrained model of acoustic impedance, constrained seismic inversion

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Structural feature in southeast margin of Aljin mountains and explorator prospect Kang Nan-chang, Qin Su-hua, Chen Yuan-zhong and Guan Jun-ya OGP, 2005, 40 (2): 233~ 237, 242

The southeast margin of Aljin mountains in Chaidam basin experienced multi-period structural movement in geologic history, resulted in complex structures. It is showed in the paper by studying faults and structural style that abnormal fault developed in the southeast margin of Aljin mountains, which formed "brush" distribution that dispersed toward the piedmont of Aljin mountains and converged toward the basin; a series of faulted noses and multiple structural styles are formed under the controlling of the press-shear faults, resulted in large difference between deep and shallow structures. It is considered by integrative analysis and evaluation for source rock, reservoir and cap that the conditions of source rock, reservoir and cap are very good, the Jurassic has hydrocarbon-generated potential, traps developed, the type of reservoir is rich and great potentialities of exploration existed. The resulted conclusions have certain guided meaning to further carry out oil/gas exploration in the southeast margin of Aljin mountains.

tains

Key words: Chaidam basin, southeast margin of Aljin mountains, structural feature, prospect of oil/gas exploration

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Gradient interpretation of step gravity anomaly Wei Wei and Liu Tian-you OGP, 2005, 40 (2): 238 ~ 242

The method for gradient interpretation of gravity anomaly presented by Stanley, Green and Butler is to first use horizontal gradient-vertical gradient map of gravity anomaly to obtain the dip angle of step and the position of origin of coordinate (intersecting line between inclined plane of step and surface), then use horizontal and vertical gradients of gravity anomaly to determine the buried depths of top and bottom of step. These operations must be finished by manual activity, and can produce major errors even be failure to be done when dips of step is more than 10°. On the basis of deducing the relationship between first and second derivatives of 2D step gravity anomaly and buried depth, dip and attitude of step, the paper made an important modification for the method presented by Stanley et al: using least variance to fit horizontal and vertical gradients of gravity by second order curve and automatically computing the dips of step; deducing the expression of computing the buried depths of top and bottom of step from second derivative of gravity and automatically computing the buried depths of top and bottom of step. Comparison with former methods, the method can more accurately and rapidly compute the attitude of step (contact field). The computed case of gravity data in Liupanshan basin is shown in the paper, which proved that the method can effectively interpret the gravitational anomaly of step.

Key words: gravitational anomaly, step analysis, incline step, inversion

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Integrative processing in synthesis of multi-logging traces Wan Ying-ming, Gao Jun, Dong Jian-ping and Yang Hong-mei OGP, 2005, 40 (2): 243~ 247

Logging trace is a basis of geologic strata-partition, but the multi-solution and limitation exist when only using a single logging trace to solve the complex geologic issues. In order to overcome the

multi-solution, the people use multiple logging traces for geologic strata-partition and the precision of strata-partition is improved. On that basis, the paper suggests a method, in which the separate weighting factors are assigned to multiple logging traces and then normalization processing is carried out, forming one nominal integrative parametric logging trace. The integrative parametric trace gives emphasis to common information of selected multi-logging traces and reduces or weakens occasional errors in a single logging trace, which increases the believable degree of post-integrative logging trace. The method can be used for strata-partition, lithologic analysis and oil/gas-bearing prediction etc. Note that there is no such case at all that the more selected kinds of logging traces the better when using the method, it must select the logging traces that can reflect the characters of formation units instead.

Key words: logging trace, synthesis, weighting factor, normalization, anomalous point, pre-processing

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Analysis of trend to complex mountainous exploration in west of China Gou Lang and He Zhen-hua OGP, 2005, 40(2): 248~ 251

Oil/gas resource is rich in piedmont of complex mountains that is one of major exploration fields

in the west of China. There are double complexities in piedmont of western mountains that characterized by both complex and variable surface conditions and strong underground feature of overthrust structure, increasing the difficulty in seismic data acquisition, processing and interpretation. The difficulties are focused on two aspects: lower S/N ratio of seismic data ratio and poorer structural precision that become a technical bottleneck of developing western seismic exploration. After near decade's technical tackling key problems, a set of experiences of complex mountainous seismic exploration has been formed, some complex structures have been successfully captured and Kela-2 gas field and Dila-2 gas field in the piedmont of Kuche foreland basin have been found. But, this success is by no means that the other problems in western mountainous exploration are readily solved. Since the seismic-geologic conditions in western complex mountains of China are complex and variable, it has to continuously develop new techniques and new equipments aimed at concrete existed problems, which can meet the needs of western oil/gas exploration.

Key words: complex mountainous exploration, prospecting situation, bottleneck problem, exploration trend, western region

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