ABSTRACTS

Design principles of seismic line layout and acquisition parameters on Tarim mountains. Yang Juyong, Xu Feng and Shi Haifeng. *OGP*, 2003, 38(3): 221~225

The acquisition operation on complex mountains is a systems engineering having a high-cost and high-risk, scientifically and reasonably designing seismic line layout and acquisition parameters on mountains is a basis of lowering both cost and risk. Starting from heavy energy losses of effective signal that is a key factor of influence on the quality of seismic data on complex mountains, the paper systematically analyzed the factors causing energy losses of effective signal, absorption on surface and in strata and mechanism of diffraction and shield. The design principles of seismic line layout and acquisition parameters on complex mountains are put forward on that basis and are applied in Quele area of Tarim basin, which achieved good results.
Key words: effective signal, absorption, diffraction, shield, explosive in high-speed layer, spread length

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Ocean Bottom Cable (OBC) acquisition method in southern Laopu area. Han Liqiang, Quan HaiYan. *OGP*, 2003, 38(3): 226~230

The southern Laopu area is transitional zone of Jidong Oilfield and offshore block, the precious data are always the 3-D seismic data, being unable to finish structural interpretation in that area. The recent 3-D seismic acquisition is in the west of the region in 2000 by AGIP Company. There exist following difficulties according to legacy data and field investigation: ①fracture development; ②multiple development in igneous rock of Ng Formation; ③rapid water depth variation. This 3-D seismic exploration is carried out in view of these problems, effectively solved the above-mentioned problems. The adopted measures are as follows: ①using OBC for PATCH wide-azimuth acquisition; ② appropriate sources being chosen in different areas; ③using first break of OBC for second positioning; ④ reasonably using 3-D recoverable shot points. The aim of the paper lies in summarizing the experiences of the exploration and improves the knowledge of OBC exploration technique at the same time.
Key words: southern Laopu area, multiple wave, ocean bottom cable, second positioning by first break

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Some experiments and analysis of seismic study on near-surface. Wang Junru and Li Hongyang. *OGP*, 2003, 38(3): 231~236

Based on some experimental results of seismic study on near-surface, the paper analyzed the intrinsic relation when using seismic refraction and all kinds of logging to determine the parameters of near-surface, discussed the reason of opposite break of first arrivals between near-offset trace and far-offset trace on seismic records and explained the importance of charge size to suppress background noise and relation between offset and received energy.
Key words: seismic study on near-surface, seismic refraction, uphole survey, experiment and analysis

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Application of pre-stack depth migration integrative processing techniques in study of Nanmeng buried-hill reservoir, Jizhong Oilfield. Liu Jun, Xu Youping and Liu Xiaohong. *OGP*, 2003, 38(3): 237~241

Nanmeng buried-hill fault structures of Jizhong Oilfield are complex, the seismic imaging of former adopted time migration method has poor resolution. The paper applied the 3-D pre-stack depth migration to re-process the seismic data of Nanmeng buried-hill, the processing flow included ordinary 3-D seismic processing, build-up of geologic model in time domain, subtle velocity analysis, build-up of velocity field, final migration imaging and post migration processing. According to re-processed pre-stack depth migration data of the structures. Fujun mountain, Changlong mountain and Wumi mountain are defined. The industrial oil flow with high production has been found in Group sandstone reservoirof of Changlong mountain.
Key words: pre-stack depth migration, seismic data processing, Nanmeng buried-hill

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Self-adaptive coherent noise attenuation technique. Gao Shaowu, Zhao Bo and Zhou Xingyuan. *OGP*, **2003, 38(3): 242~246**

Noise elimination is a necessary, there are all kinds of coherent noise on seismic records because of many reasons caused by shooting, propagation and receiving of seismic wave. Aimed at the coherent noise in seismic data processing, the paper presented self-adaptive coherent noise attenuation technique in time-space domain, separating signal/noise. The method looks to the apparent velocity, that noise is on whole processing plane, approximately as constant (positive or negative value), which can effectively eliminate the linear noise, surface wave and multiple etc. , and has HI-FI signal, that is ideal noise elimination method for seismic data processing in complex area and area having low signal-to-noise ratio, having the advantages of high operation speed and good noise-suppressed effect .

Key words: coherent noise, seismic records, linear transformation, separation of signal and noise, linear inversion, frequency-division processing
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Minimum dispersion algorithm by finite-difference numeric modeling and its applications. Cai Qixin, He Peijun, Qin Guangsheng, Qin Yaling, Ji Ping, Meng Fanbing and Wang Xiwen. *OGP*, **2003, 38(3): 247~251, 262**

The finite-difference approach is common-used algorithm for numerical solution of wave equation, but ordinary finite-difference algorithm is difficult in overcoming the interference of numeric dispersion. On the basis of summarizing and analyzing the former methods, the paper integrated and expanded the relative techniques and got optimized finite-difference algorithm, the main concepts includes high-order finite-difference, optimized difference parameters and Flax-Corrected Transport (FCT) technique. Based on the algorithm, we wrote corresponding program , improving precision of wave equation forward modeling and reducing computational effort in comparison with ordinary methods, which can be widely used for wave field modeling and analysis in relief topography and complex subsurface geologic structures and achieved satisfactory results in coal seam model

and forward modeling in BM work area.

Key words: wave equation, seismic modeling, finite-difference algorithm, dispersion, minimum dispersion algorithm
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Seismic forward modeling by arbitrary difference precise integration. Wang Runqiu, Geng Weifeng and Wang Shangxu. *OGP*, **2003, 38(3): 252~257**

The paper improved the following methods: single-point sub-domain integration for parabolic equation presented by Zhong Sixie and arbitrary difference for temperature field problem presented by Qiang Shizhong, presented a arbitrary difference precise integration (ADPI) algorithm of wave equation. The formula of ADPI is theoretically deduced and its realization way is given in the paper; the space and time resolution and the stability of difference format are discussed theoretically and proved in real case. The theoretical analysis and real cases showed the high precision of the presented method in the paper. The presented seismic forward modeling cases showed that the method is suitable for complex near-surface and structural geologic body.

Key words: forward modeling, wave equation, finite difference, arbitrary difference, precise integration, complex near-surface, seismic model
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Using multivariate seismic attributions to predict reservoir information. He Bizhu, Zhou Jie and Wang Gonghuai. *OGP*, **2003, 38(3): 258~262**

Seismic attribution analysis technique plays a more and more important role in lateral reservoir prediction. Using multivariate seismic attribution analys technique for prediction of reservoir information is mainly based on spatial variation of rock characters and fluid properties in reservoir, resulted in variation of seismic attributions such as seismic reflected waveform, amplitude and frequency etc. . The paper mainly described that using classification (cluster) analysis and multivariate seismic attribution regression technique to analyze the vertical and lateral reservoir variation characters in special areas, and puts stress on the predicted reservoir distribution scope and physical properties of reservoir in a model of regional geologic concept. The real cases showed that the predicted re-

sults by the method well coincides with drilling data.

Key words:seismic attribution,multivariate regression,reservoir prediction

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Multi-well constrained velocity model-building method and its application. Wang Xiwen, Liu Quanxin, Su Mingjun, Liu Junying and Li Kongchou. *OGP*, 2003, 38(3):263~267

Based on the characters of structure study at development stage and in order to meet the need of structure study,the paper presented the method for multi-well constrained velocity model-building structure mapping which includes following contents:space correction for inclined hole,multi-well calibration,multi-well constrained velocity model-building and velocity-variable structure mapping with high-precision. The method is proved to be effective by taking the study of structure in Ban'nan 4-2 well-site,Daganng Oilfield for example in the paper.

Key words: development stage, structure study, multi-well constrained, velocity model-building, Ban'nan 4-2 well-site

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Application of amplitude tuning in surveying geologic target thickness less than 1/4 wavelength. Ling Yun study group. *OGP*, 2003, 38(3):268~274

The dominant imaging frequency acquired by seismic acquisition in an area has its limitation because of attenuation by earth absorption and influence of interference. This limitation is called as resolution limitation of 1/4 wavelength. Normally,the limitation is often difficult to meet the demand of geologists for surveying thin and interbedded geologic targets (especially in development seismic exploration). Through processing and interpretation of real 3-D seismic data in a reservoir (pinch-out) condition of depth of 5000 m and thickness of 0~ 35m, the paper studied pinch-out boundary which thickness is less than 1/4 wavelength. Through adopting the processing flow of relative reserving amplitude and improving resolution and on the basis of calibration by seismic logging and VSP data and interpretation of subtle structures, the paper

makes recognition of seismic amplitude and waveforms along the beds and synthetic analyses of forward modeling and development information . The analyzed results showed that we can identify such geologic bodies as thin lenticular sand and lithologic pinch-out etc. by amplitude-tuning role. The set of processing and interpretation approaches are particular suitable for lithologic oil-gas reservoir's exploration in Chinese continental sedimentary environment.

Key words:amplitude,tuning function,HI-FI,high-resolution, 1/4 wavelength,thin sand body,lithologic pinch-out,recognition

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Study of general effective medium HB resistivity model in mixed shaly sands. Song Yanjie, Lu Guiyou, Wang Chunyan and Li Pengju. *OGP*, 2003, 38(3):275~280

Based on the effective medium HB resistivity models in laminated or dispersed shaly sands proposed by Berg,the general effective medium HB resistivity model in laminated and dispersed shaly sands is established in the paper. In the derivation of the model we assume that clay-bound water fraction is included in total pores,the resistivity of clay-bound water and formation water has not been considered, and their differences are incorporated into clay grain conductivity. By analyzing influence parameters of the model,we find out that shale distribution largely affects water saturation calculated by the model, the less the resistivities of sand grains or clay grains,the more largely the resistivities of grains affect the relation between C_t (conductivity of shaly sands)and S_{wt} (total water saturation),the effect of m (cementation factor)($m= n$) on the relation between C_t and S_{wt} is increased with S_{wt}. Testing on artificial samples with conducting rock grains,it proves that the model can be applied in clay-free porous rocks with conducting grains,but formation water resistivity must be less than rock grain resistivity. Testing on rock sample data in dispersed shaly sands,it shows that introducing another parameter n ($n\neq m$) to the model can decrease the relative error of fitted C_t. However, when we consider the difference of electrical properties between clay-bound water and formation water in the model,although another parameter is added to the model, the relative error of fitted C_t is increased slightly. Testing on logs in laminated shaly sands,it demonstrates that the model

can be applied in laminated shaly sands. Through practical application, the test of effects of R_{dc} and V_{dc} representing clay resistivity and fraction or dry clay resistivity and fraction on water saturation calculated by the model proves that it is very reasonable for R_{dc} to be clay resistivity and V_{dc} to be dry clay fraction, so the model derived from the paper can be used to evaluate shaly sands.

Key words: shaly sand, dispersed clay, laminated shale, effective medium theory, HB equation, water saturation, general resistivity models

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Concept and application of seismic cycle characteristics. Zhang Junhua, Wang Yonggang, Yang Guoquan, Zhao Yong and Huang Guoping. *OGP*, 2003, 38(3):281~284

The paper studied the cycle characteristics of theoretical model, gave the time-frequency responses in different models and highlighted the discussion on design of time-frequency filter and setting of display parameters, resulted in that the ideal results can be got if adopting triangular filter with frequency band of 1.2 octaves and the dominant frequency of 1.05 recursive ratios. The paper took the TN and QNQ work areas having different lithology as examples, highlighted the analysis of seismic cycle characteristics of sand-mud reservoir and limestone reservoir, achieved good applied results.

Key words: theoretical model, time-frequency filter, sedimentary cycles, sand-mud reservoir, limestone reservoir

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Fractured reservoir detection by bispectrum. Chi Xingang, He Zhenhua, He Xilei and Huang Deji. *OGP*, 2003, 38(3):285~289

The paper analyzed the identified ability of phase spectrum and amplitude spectrum in different phase systems, discussed the sensitivity of phase spectrum and amplitude spectrum to weak amplitude variation and the impact of random interference on phase spectrum and amplitude spectrum. The advantages and disadvantages of phase spectrum and amplitude spectrum are analyzed by using forward model. The methods using bispectrum to detect fracture are presented; the phase spectrum can better predict regional fracture distribution because of its sensitivity to weak amplitude variation and strong ability in anti-random interference; the amplitude spectrum is suitable for total fracture distribution because of its better detection results for strong amplitude variation. Finally, integrating bispectrum detection methods in application of real data achieved good results.

Key words: bispectrum, fracture, amplitude spectrum, phase spectrum

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Identifying condensate gas-oil ratio from well logging. Gao Chuqiao, Zhang Chengguang, Xiao Chengwen and Song Fan. *OGP*, 2003, 38(3):290~293

Condansate gas has physical characters between oil and dry gas, which is difficult to distinguish them by well logging data. Using optimization principle to calculate the contents of condensate oil and condendate gas separately in an condition of reservoir, the paper calculated the gas-oil ratio on surface from above results. It is proved by production test in 13 layers from 6 wells that the gas-oil ratio calculated from well logging information can more correctly identify condensate gas reservoir.

Key words: well log, gas-oil ratio, condensate gas reservoir, reservoir pattern

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Study of well logging method for reservoir with low resistivity in Mazhai Oilfield. Ren Guanghui, Wang Weiping, Ge Qiuxian and Li Xinxin. *OGP*, 2003, 38(3):294~296,307

There exists the reservoir with low resistivity in upper and lower layers in Es$_3$ formation, Mazhai Oilfield. Computed oil saturation is lower than 50% and its bound water saturation is 60% and above in this kind of reservoir. Adding formation water with higher salinity, conductibility is increased and resistivity is decreased, formed the reservoir with low oil saturation and low resistivity. Based on the feature, we use natural gamma-neutron logging and density logging to appreciate the formation parameters. We use analyzed results of drill cores and median grain diameter to compute bound water saturation of formation. The reservoir

fluid dynamics is synthetically analyzed by using reservoir theory, the reservoir is appreciated by bound water saturation and formation water saturation. A set of formula and drawing board for interpretation has been created.

Key words: reservoir with low resistivity, logging method, distributed feature, forming mechanism, regression analysis, median grain diameter, bound water saturation

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Control role of lateral oil migration along fault on Mesozoic reservoir-forming of Kongxi fracture belt. Lu Gangchen, Li Tinghui, Kong Fandong, Yang Anyuan, Luo Minxue and Cui Jingtao. _OGP_, 2003, 38(3):297~302

The exploration in Mesozoic of Kongxi fracture belt has been logged down because of lack of systematic analysis on key factors. On the basis of analysis of macro-structural setting, the paper firstly figured out the scope, the inner traps and main faults of Kongxi fracture belt and explained Mesozoic different key reservoir-forming factors of the fracture belt; secondly, the paper further discussed the geologic features in terms of topography, distribution of hydrocarbon source rock, relative positional relation of oil-generation formation-reservoir and attitude and active intensity of main fault. The fracture belt has the condition of lateral oil migration along fault that has been proved by the results of oil analysis. Finally, we sought the favorable targets following that migration pattern and found out that there is still great prospecting potential at the both ends of Kongxi fracture belt.

Key words: Kongxi fracture belt, structural setting, key reservoir-forming factor, lateral oil migration along fault

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Preliminary probe of application of sequence-stratigraphy technology. Sun Zhihua, Wu Qizhi, Zheng Junmao and Gan Changhua. _OGP_, 2003, 38(3):303~307

Combining real research cases and according to main contents studied by sequence-stratigraphy, the paper probed the key techniques applied in sequence-stratigraphy analyses. Time-frequency analysis technique and forward and inversive modeling technique are applied in sequence-stratigraphic classification; advanced techniques such as wide band-constrained inversion, coherent data volume and 3-D visualisation etc. are applied in characteristic sequence-stratigraphy analysis, portraying carefully the characters of sequence-stratigraphic system; the key techniques such as wave geology and balanced geologic cross section etc. are adopted in sequence-stratigraphic cause of formation. Application of the above-mentioned approaches in real cases achieved tangible results.

Key words: sequence-stratigraphy, time-frequency analysis, wide band-constrained inversion, wave geology

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Test and analysis of geophone's free frequency in seismic acquisition. Wang Zengming. _OGP_, 2003, 38(3):308~316

The tests of geophones with different free frequency are conducted in order to improve resolution. It is considered by tests that the geophones have different free frequency, showing as different suppression for low-and high-frequency interference in single shot records, but there are no distinct differences in frequency and energy between several geophones after data processing. The high-resolution exploration is not equal to high frequency exploration, but is wide band exploration instead, so that selection of geophone with low free frequency is suitable for high-resolution exploration.

Key words: geophone, free frequency, high-resolution, seismic exploration

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Application of image processing techniques to geophysics. Zhang Lili, Wu Jiansheng and Wang Jialin. _OGP_, 2003, 38(3):317~323

The advantages of geophysical images are not only straightforward and visual, but also lie in the fact that they can be processed by image processing methods so as to improve the capacities of solving geophysical and geological problems. In this paper, some kinds of geophysical images are described and the image processing methods applied in geophysics are introduced, from which pointed out that the techniques of image enhancement, reconstruction and analysis are now widely used in geophysical data processing, and synthetic analysis of multi-source data based on image processing is a research

trend. Considering the differences between geophysical image and ordinary image, the knowledge of problems that need to pay attention to in a process of image processing are given in the paper. Combing with GIS (Geographic Information System) gradually penetrated into geophysical study, the prospect of application of image processing to geophysics is described.

Key words: image processing, geophysical image, synthetic analysis

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A effective 1-D MT direct inversion scheme. Chen Qingli, Yang Zhonghai and Hu Wenbao. *OGP*, 2003, 38(3): 324~327

At the given frequency, the apparent resistivity of magnetotelluric sounding (MT) reflects the average resistivity at the range of penetration depth of that frequency. The electro-magnetic wave with different frequency has different penetration depth. The algorithm firstly determines the subsurface resistivity and evaluates their thickness depending on the maximum frequency point and apparent resistivety; then determines the resistivity and thickness of equivalent layer parallel connecting both first and second layer; after that, the algorithm determines the resistivity and thickness of second layer from that of first and equivalent layer; and so on, finally we got the parameters of each electric layer from top to bottom. The algorithm needs neither initial model nor data fitting. The inversion of theoretic data with different model showed that the method is effectiveness in dividing conductive formation. The inversion results and the real models matched well.

Key words: MT, MT direct inversion, equivalent resistivity, apparent resistivity

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Analysis of rock pore throat structure with NMR spectra. Liu Tangyan, Wang Shaomin, Fu Rongshan, Zhou mingshun, Li Yanhua and Luo Man. *OGP*, 2003, 38(3): 328~333

Both NMR T_2 spectra of core and mercury intrusion capillary pressure can be used to characterize pore throat structures of rock in some degree. Theoretical analysis reveals correlation between these two sets of data. Determining the transferring coefficient between T_2 and P_c is the key step when NMR spectra are utilized to study rock pore throat structure. In earlier methods, some characteristic parameters of rock should be given in advance before transferring T_2 into P_c, which is difficult to determine these parameters precisely in practice. By using directly correlation between NMR spectra and mercury intrusion capillary pressure, a new method is presented in this paper to determine the transferring coefficient objectively. As a result, all the difficulties determining rock parameters are avoided. With this new method, after comparison and analysis of calculated various NMR spectra in 6 rocks, NMR (Nuclear Magnetic Resonance is called NMR for short) T_2 capillary pressure curve and pore throat distribution are given, and the results are compared with the analysis of mercury intrusion capillary pressure. Our research shows that NMR T_2 spectrum of core holds a little predominance in practical application and evaluation precision. In saturated oil rock, NMR T_2 spectra of core can be still utilized to evaluate the distributions of pure throat, the relaxation character of oil-gas exists as an influence background value, which may have limited effects on the evaluation results. The transforming coefficients of the 6 samples, ranging 2500 ~ 4000 $\mu s \times MPa$ are given in the paper.

Key words: NMR, rock pore throat, mercury intrusion analysis, relaxation, capillary pressure, correlation analysis

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