ABSTRACTS

Analysis of explosive effect of dynamite source. Qian Rongjun. *OGP*, 2003, 38(6): 583~588

Starting from the basic principle of spherical wave propagation and through solving the Kirchhoff integrated formula, the paper analyzed the relation between the curvature radius of spherical wave front and wave field strength during propagation of elastic wave and pointed out the influence of produced equivalent cavity form on seismic wave strength; the amplitude of elastic wave in a direction and equivalent cavity are direct proportional to the curvature radius in that direction. On the basis of the theory the dynamite type and form in practice has been analyzed. It is considered that using long and thin charge column and charge cluster for shooting does not form equivalent cavity having larger curvature radius, so that the effect of increasing explosive energy has not been achieved. Therefore, the paper presented the basic methods for reasonable selection of dynamite type and form and made reasonable suggestion on major issues that ought to be considered.

Key words: dynamite source, wave front curvature, wave field strength

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Energy shielding action of shallow strong reflector. Wang Jianhua, Li Qingzhong and Qiu Rui. *OGP*, 2003, 38(6): 589~596, 602

When a strong reflector existed in shallow layer, because of the energy shielding action of the reflector, the seismic wave is difficult to penetrate through the reflector and transmit, which can not be reflected back to surface. Adopting Zoeppritz equation and facing with several typical region of China, the paper designed different model to analyze the energy-shielding action by shallow strong reflectors, proved the reason why the seismic data did not be acquired in these regions and presented six solved methods: ① avoiding shot in the areas having thicker sub-weathered zone as far as possible; ② shot-hole must be drilled through the shallow strong reflectors; ③ using converted shear wave for prospecting; ④ using planar wave-front method or shooting in large group interval of shot-array; ⑤ using dynamite source having directional characteristic; ⑥ doing more effort in processing if there appear strong reflectors such as igneous rock or coal-bearing formation in middle or deep layer.

Key words: shallow strong reflector, energy-penetrated window, effective receiving window, converted S-wave, plane-wave front method

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Full-wavefield modeling by slowness method and realization of horizontal slowness integration. Zhang Fanchang, Yin Xingyao and Zhao Jian. *OGP*, 2003, 38(6): 597~602

The inversion of pre-stack seismic data needs to take some forward algorithms as a basis. Starting from elastic dynamic equations, the paper adopted slowness method to compute the pre-stack seismic records in layered medium. The slowness method can provide the complete solution for seismic wavefield like reflectivity method, including the information of primary reflection, multiple and converted wave resulted from propagation of seismic wave in beds and intermediate results can be easily interpreted. The concrete steps of realization is as follows: ① the constitutive equations and elastic dynamic equations are transformed into frequency-slowness domain by Fourier transform and Hankel transform; ② the recursive formulas of reflectivity and transmissivity matrixes are resulted in frequency-slowness domain; ③ the seismic data gathers can be resulted from integral transformation for frequency and slowness separately. The stability problem on solution in computing slowness is also discussed in the paper.

Key words: slowness method, pre-stack seismic data, inverse Hankel transform, slowness integration

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Study of NMO correction method by optimized sixth-order term. Hu Zhongping. *OGP*, 2003, 38 (6): 603~607

Along with development of seismic exploration by longer spread, the NMO correction by second order term doesn't meet the needs of NMO precision of longer spread, but high-order equations face with the problems that have complicated parameter and large computational efforts. On the basis of analyzing Tariq equation and according to the method presented by Tsvankin et al, the paper introduced time-distance curve expression—NMO

correction equation with optimized sixth-order term, which has rapid computational speed and simplified equation parameters. Because of smaller truncation errors of expansion equation than sixth-order term of its Taylor series, so it has higher precision. The results from synthetic records and seismic data show that adopting the equation with optimized sixth-order term has better effects than that of sixth-order Taylor series in NMO correction for seismic data with longer spread, which has good correlation for seismic events of different offsets, avoiding smear and making stack section have higher resolution and continuity.

Key words: seismic data, processing, longer spread, NMO correction with sixth-order term, truncation error

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A New Method of 3-D refracted first-break static correction. Zhang Jianzhong and Wang Kebin. *OGP*, 2003, 38(6): 608~610

The paper presented a new method for 3-D refracted first-break static correction, which includes following steps: ① the surveying plane is divided into many CMP bins and delay-time in low frequency and velocity of refractor at CMP point are calculated according to refraction travel-time equations within each bin ; ② double linear interpolation for delay-times in low frequency and velocities of refractor at adjacent CMP points is carried out, resulted in delay-times in low frequency are converted to long-wavelength statics; ③ the corresponding delay-times in low frequency and refracted times subtracted from first-break travel-times leave residual refraction travel-times in high frequency, and similarly, these residual travel-times are decomposed to short wavelength statics at shot points and receiver points; ④ the resulted long wavelength statics are added to resulted short wavelength statics at each shot point and receiver point resulted in total statics at each shot point and receiver point. The method resulted in good applied effects in 3-D static corrections in desert area.

Key words: 3-D static corrections, refraction travel-time, CMP bin

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A new method for determination of floating datum in static corrections. Lin Boxiang. *OGP*, 2003, 38 (6): 611~617

The datum is an important parameter in statics calculation. The general assumption in calculating static correction is that the near-surface ray-paths travel vertically, which does not conform with the actual travelling path of ray. If selecting different datum, the corresponding results of velocity analysis and stack are different too. So the errors of static corrections resulted from the assumption brings a bad results. The paper analyzed the relation between the errors of static corrections and the position of datum as well as the structure of low velocity layer, analyzed the results of velocity analysis for different floating datum and influence of the errors of calculating static corrections and presented the determination method for floating datum having minimum errors of calculating static corrections. The stack velocity calculated on the floating datum depends on the velocity of medium underlying the low velocity layer and is independent of topography and low velocity layer. The stack velocity resulted from using the method for static correction can be directly used for time-depth transformation; the root-mean-square deviation of time after NMO is smaller, which is suitable to realize in-phase stack.

Key words: static correction, united datum, floating datum, low velocity layer, velocity analysis

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Seismic trace interpolation by using L_1 norm to calculate time-difference between traces. Lü Xiaowei, Chen Xiaohong and Diao Shun. *OGP*, 2003, 38 (6): 618~622

The paper adopted method using L_1 norm to calculate the time-difference to compute time-dip at each point of section and carry out dip interpolation trace by trace. When large gap exists, the shift time corresponding to point having minimum absolute value among differential-value gathers is found according to minimum standard of L_1 norm, then the time-dip is calculated and interpolation is carried out. The method is suitable to both linear or nonlinear interpolation and event interpolation with equal or unequal group interval. The synthetic and real data processing showed that comparing with ordinary trace interpolation method the method has the advantages of high-speed, high-precision and good suitability.

Key words: L_1 norm, time-difference between traces, time-dip, non-linear interpolation

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Theoretical study of detectable cavern-fractured reservoir in weathered Karst of deep carbonatite. Yao Yao and Dang Wenbang. *OGP*,2003, 38(6): 623~629

The paper used the random medium model and non-homogeneous elastic equation to carry out systematic forward modeling and a lot of theoretical analysis. The results of forward modeling provided a solid basis for study of detectability of caves and study of characteristic seismic response to fluid-filling caves. The study showed that using the seismic data with ordinary frequency band (dominant frequency is 20~40Hz) can detect the caves having 2 ~ 15m in height of fluid-filling caves,determine its spatial distribution and boundary and evaluate its height. Under the condition of ordinary band (20~40Hz) and that the height of caves changes within the scope of 2 ~ 15m, the height of caves has a little influence on the amplitude of vertical component of diffraction and hardly on its horizontal component. The forward modeling technique using the random medium model and non-homogeneous elastic equation can do forward modeling of super miniature (10^0m grade) caves having any forms,which provides a reliable method for forward modeling of non-regular, heterogeneous and super miniature geologic body that is similar to the caves.

Key words: oil-gas reservoir in cavern-fractured carbonate, forward modeling,random media model,heterogeneous media,elastic wave equation

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Study of S-wave test and measurement technique in laboratory. Wei Jianxin and Wang Chunyong. *OGP*,2003,38(6):630~635

Study of S-wave in laboratory is paid more and more attention to in geophysical exploration. Affecting by many factors during test of S-wave in the laboratory, such as the characteristics of S-wave transducer, the size and structure of core sample,test position and coupler,the S-wave test and measurement in laboratory is more difficult than P-wave survey. Starting from knowing the structures and characteristics of S-wave transducer,the paper listed the use of various kinds of S-wave transducer and some skills of S-wave test and measurement. It's need to pay attention to following items in order to obtain high-quality of results of S-wave test: ① the polarizing characters of S-

wave transducer is needed to carefully known; ② honey and tinsel are best coupler; ③ the polarization of transducer in transmitter and receiver must be coincident in uniform and homogeneous medium; ④it must pay attention to the conversion of vibrated mode when the radius of core sample is less than 25 mm.

Key words: S-wave test and measurement, S-wave transducer, shear wave, torsional shear wave, polarization,coupling

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Tomographic inversion for 3-D complex near-surface model and static correction. Li Luming and Luo Xingxian. *OGP*,2003,38(6):636~642

In view of complex near-surface issue in 3-D seismic exploration,the paper presented a method for tomographic inversion by using 3-D first-break near-surface model and for static correction. Using 3-D seismic direct wave, bow tie, refracted wave and first break composed of above the three modes and 3-D tomographic inversion having advantage of 3-D spatially-varying velocity, the method can achieve tomographic inversion in 3-D complex near-surface model which the velocity can change arbitrarily; the demand of the method on the first break is only detecting the break-time of first-arrived wave without interpretation of the wave mode; 3-D network ray-tracing method based on Fermat's principle is adopted in the 3-D forward modeling;the damping least-square QR decomposition iterated algorithm is adopted in 3-D tomographic inversion. Adopted above-mentioned methods can both improve the reliability of tomographic inversion for near-surface velocity model, provide reasonable near-surface velocity model for tomographic static correction of 3-D seismic data and improve the computational efficiency, increasing the practicality of the method.

Key words: 3-D tomographic inversion, 3-D tomographic static correction,3-D first break,3-D near-surface velocity model

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Study on application of basic seismic attributes to interpretation of depositional environment. Ling Yun. *OGP*,2003,38(6):642~653

Seismic attributes have broaden application in hydrocarbon detection,prediction of reservoir parameters and sequence-stratigraphic interpretation,

but application of seismic attributes to interpretation of depositional environment is rarely seen. The purpose of the paper is to prompt the study in this domain. Among multiple seismic attributes, the instantaneous amplitude, instantaneous frequency, instantaneous phase and coherent data volume as well as waveform clustering can be basically defined as basic seismic attributes, the other seismic attributes have direct and indirect relation with these 5 basic seismic attributes. These 5 basic attributes can reflect some depositional phenomenon; instantaneous amplitude can reflect the difference between impedance of formation (velocity and density)and porous fluid; instantaneous phase can describe the boundaries of lithologic changes and some anomalous bodies, coherent data volume can reflect the spatial changes in geologic bodies; waveform clustering can reflect the spatial similarity of geologic bodies. In order to improve the believable level in adopting basic seismic attributes to interpret the depositional environment, use of wide-azimuth survey is useful, adoption of relative amplitude-preserved high-resolution processing is necessary condition, how to reasonably optimize reference marker beds and calibration to calibrate the logging information are also the important guarantee of success in interpretation. The conditions selecting reference marker beds are: ①the formation has similar depositional environment in research area; ②the formation must be in same depositional cycle as the targets, or in same period of seismic wave. The study showed that using above-mentioned method to detect seismic attributes can result in such depositional environment information that the seismic resolution can be less than 1/4 wavelength, that means, the method can be used for interpretation and prediction of depositional microfacies, providing important information for looking for prospective reservoir.

Key words: instantaneous frequency, instantaneous phase, instantaneous amplitude, coherent data volume, waveform clustering, depositional environment
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χ^2 distribution processing of deep seismic reflection in north of Songliao basin and its deep geological feature. Chen Zhide, Yang Wencai, Li Ling and Wang Liyan. *OGP*, 2003, 38(6): 654~660

One of major difficulties in a process of deep geologic interpretation by using deep seismic reflection data is to identify coherent events of seismic reflection under high noise background, which can determine the model of underground reflection structures. Common-used method is to draw line plot, aimed at simplifying seismic reflection and emphasizing underground reflection structures. On the basis of summing up more than 20 years' development of deep reflected seismic technology, the paper presented and completed χ^2 distribution technique of deep reflected seismic data. According to characters of deep reflected seismic technology and starting from the angle of reflected structure and energy, the method emphasized the deep structures. It is considered by interpretation that the sections with deep reflected structural line plot resulted from χ^2 distribution processing can clearly reflect the recent structural framework, the sections stacking structure and energy plot together are characterized by the distinction between strong and weak reflection; the weaker reflection represents the trail remained by older structural movement or by structural movement having a smaller amplitude; the stronger reflection represents the trail remained by newer structural movement or by structural movement having a larger amplitude. Speaking from the petrophysical angle, the deep reflection profile characterized by the distinction between strong and weak reflection represented different contact relation of lithology and their divided boundary, for example, the stronger reflection from extensional lower crust represents tough shear zone. The studied results show that Songliao lithosphere has character of typical continental rupture rift: a over 20 km thick Phanerozoic strata, uplift and crushed Moho and fault system resulted from tensile and intermittent press, which is considered that significant thickness of Mesozoic and Paleozoic layers existed in middle and upper crust and is accompanied with fracture system penetrating the crust, having better deep oil-gas migratory and accumulational prospectiveness.

Key words: deep reflected seismology, χ^2 distribution, reflection-structural mode, section with structural line plot, section stacking structure and energy plot together, tensile rupture rift, crust
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Measuring directivity of phased-array acoustic transmitter in acoustic log. Chen Xuelian, Qiao Wenxiao and Li Gang. *OGP*, 2003, 38 (6): 661 ~ 665, 679

The paper studied the measurement method for directivity of phased-array acoustic transmitter in acoustic log by experimental modeling method.

Three phased-array acoustic transmitter in different structure used for acoustic log and relevant multi-channel signal source are made by ourselves in laboratory and using high-precision positioning system and data acquisition system to measure the vertical directivity of each phased-array acoustic transmitter in the water. The experimental results showed that along with increasing the delay-time of impulsive signal on adjacent array elements, the steered radiation angle of acoustic beam of phased-array becomes larger and larger. The direction of acoustic beam and angular width of main lobe can be changed by properly amplitude-weighting, decreasing the frequency of impulsive signal and adjusting the interval of array elements. Comparing the experimental results of directivity with theoretical computation has good consistence. The adjustable and controllable characters of acoustic direction and angular width of radiation main lobe in acoustic transmitter are of great importance to new generation of acoustic log and cross-hole seismic exploration.

Key words: acoustic log, phased-array transmitter, radiation, acoustic beam, array element, directivity
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Role of faulted structure in oil-gas accumulation: case of Quti oilfield, Jiyang depression. Sui Shuling and Zhao Kailian. *OGP*, 2003, 38(6): 666~670

Quti oilfield is characterized by crushed structure, many faults and small faulted block. The structural fracture plays an important role in oil-gas accumulation. Combining with structural evaluation of the region, the paper divided Neogene lake basin fault depression stage into three extending sub-stages, the structural attitude is different in each sub-stage of basin, forming the structural attitude of Quti horst that is characterized by "belts in east-west direction and blocks in north-south direction". The oil-gas abundant grade of the region depends on lateral sealing characteristics of faults. It is considered by the analysis of multi-factors having influence on lateral sealing characteristics that I, II and even IV grade of fault in Quti oilfield generally have better sealing characteristics; inner side of arc fault or developed segment of zigzag fault has better sealing characteristics than that of smooth and straight segment of fault; the shift fault having near S-N orientation generally has better sealing characteristics. Around above-mentioned faults, there are a lot of oil-bearing formation and high oil column on profiles and large

oil-bearing area and high abundance on map; on the contrary, the faults of E-S orientation formed in Paleogene depositional stage generally have poorer sealing characteristics.

Key words: structural evaluation, fault, sealing characteristics, oil-gas reservoir, accumulation
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Determination of Weizhou-Shigouyi detachment structure and its geologic meaning. Wang Feng, Liu Chiyang and Zhao Hongge. *OGP*, 2003, 38(6): 671~674

Taking the features of seismic reflection as a basis and combining with regional geologic characteristic, the Weizhou-Shigouyi detachment structure that was formed by basement detachment of western Ordos massif from south to north is determined in the paper. On the seismic section it shows multi-layers' parallel reflections above detachment interface, and the chaotic seismic reflection resulted from complex deformation in frontal overthrust nappe has failed to appear, on the plane, the detachment structure formed clear structural discordance with neighboring areas; it came into being after detachment from south to north along coal measure strata nearby T_9 interface under the gravity action, under such structural background that the large scale of overthrust nappe of late Jurassic west massif in east-west direction formed the south part being higher and the north part being lower, its east, west and north boundary connected with neighboring by faults. The structure is composite syncline consisted of exotic sheet and structural deformation is relatively simple. In strongly structure-deformed area of western Ordos massif, the detachment from south to north under the gravity action formed simply structure-deformed and integrite Shigouyi composite syncline overlying on the autochthonous sheets, which has importance to the study of structural history and the arrangement of oil-gas exploration in that area.

Key words: detachment, feature of seismic reflection, overthrust nappe, sheet, composite syncline, structural deformation, Ordos basin
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Study on application of velocity-field model-building method. Shao Yu, Li Xueyi, Kong Zhiyong and Wang Jianmin. *OGP*, 2003, 38(6): 675~679

The former seismic velocity generally is divided into two separately independent parts: the first

part mainly is static corrections, coherent processing and velocity analysis, which all takes improving imaging as a goal; the second part is to interpret the velocity analysis and mapping, which takes obtaining the geologic results as a goal. The velocity-field model-building method introduced by the paper is to combine the above-mentioned two parts together to carry out integrative analysis, using spatial field, ray tracing and model iteration of 3-D static corrections and combination with 3-D velocity field to finish structural map, greatly improved the velocity precision. The method has been used in P5 well zone, Junggar basin, and discovered structure with amplitude 40m and area $42km^2$, which is oil-bearing structure proved by P5 well. On 2-D seismic structural map, the structure did not exist; and on 3-D t_0 isogram, only the trap with about amplitude 5ms is discovered.

Key words: seismic interpretation, velocity field, model simulation, structure with lower amplitude

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Application of joint-inversion of gravity, magnetic, electric and seismic data to exploration in Hefei basin. Jia Hongyi, Chen Jianping, Tan Mingyou, Yan Hanjie and Li Xuetian. OGP, 2003, 38(6): 680～686

On the basis of multiple exploration methods such as high precise gravity survey, aeromagnetic survey, electrical survey and seismic prospecting (simplified as gravity, magnetic, electric and seismic)developed in Hefei basin, the paper built up the feature of geophysical field in the whole area through object-oriented processing of gravity, magnetic and electric data; applying joint-inversion of above-mentioned geophysical data resulted in following results: ① finished the structural maps of Indosinian interface and crystal basement; ② discovered "shadow basin "; ③divided the region into four structural belts from south to north: foreland thrust belt, foredeep depressed belt, fore-bulge fault-folding belt and back-bulge slope belt; ④ pointed out the foreland thrust belt and fore-bulge fault-folding belt are prospective areas that can make oil-gas exploration breakthrough in Hefei basin.

Key words: joint inversion, shadow basin, region division, Hefei basin

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Application of seismic interpretation technology in N-50 well zone. Sun Zhihua, Zheng Junmao, Gan Changhua and Ding Shiwen. OGP, 2003, 38(6): 687～689

On the basis of fine 3-D seismic data, the paper used coherent data volume technique, TDQ (Time-Depth Quality) technique for fine fault interpretation of Second Sand Member of Aershan Formation in N-50 well zone of Erenaoer depression , Erlian Basin and built up a fine structural model; using neural network technique for automatic identification of seismic facies, accurate division of 5 seismic facies, and further using the analysis of single well facies to transform these 5 seismic facies to depositional facies; then the distribution of each depositional facies can be defined; finally, the paper pointed out that the underwater distributary channel facies in frontal fan delta is a favorable depositional facies.

Key words: coherent volume, structural model, neural network, seismic facies

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Difference of wave-equation between exploration seismology and development seismology as viewed from multi-phase medium. Yu Wenhui, Zhang Liqin, Wang Jiaying and Zhou Yuqi. OGP, 2003, 38(6): 690～700

Exploration seismology takes the study of reservoir structure as object and development seismology takes the study of details of reservoir structure and feature of fluid reserve in structure. On the basis of correctly describing the physical conception of sedimentary press, the paper first deduced motion equation in bi-component composite uneven medium and further deduced displacement motion equation in exploration seismology and development seismology on that basis. The difference between both of them lies in different prestress, the prestress in exploration seismology is "work" that gradient of equivalent damping force caused by combinational effects of different factors during propagation of elastic wave in multi-phase medium applies on second phase's medium; and the prestress in development seismology is "work" that gradient of porosity pressure applies on second phase's medium.

Key words: exploration seismology, development seismology, multi-phase medium, composite uneven medium, motion equation

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