

## ABSTRACTS

**Study and application of multi-level-delayed explosive source.** Xu Shuhe, Yu Jing, Hu Lixin, Liu Taisheng and Shi Xingwen. *OGP*, 2003, 38(4): 341~349, 357

On the basis of concentrated energy source and in order to meet the needs of current development of seismic exploration technique, a new type of explosive source multi-level-delayed explosive source is developed. The paper described the principle of multi-level-delayed explosive source, modeling test indoor and site test for multiple of surface structures and different exploration targets, achieving obvious effects. In comparison with ordinary charge source, the multi-level-delayed explosive source has strong superiority: improving explosive energy, extending high-frequency signal, improving explosive directivity, reducing interference caused by explosive and improving signal-to-noise ratio.

**Key words:** explosive source, multi-level delay time, distance between levels, incident angle, band width, dominant frequency, wavelet

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**Application and study on wide-azimuth seismic exploration.** Ling Yun Study Group. *OGP*, 2003, 38(4): 350~357

Hardware equipment of seismic exploration has been gradually developed in recent years, the numbers of acquired seismic trace are expanded from original several hundreds to several thousands, even ten thousands, which makes land wide-azimuth 3-D seismic exploration possible. Through cases study of wide-azimuth acquisition, processing and interpretation in the west of China and after comparison of differences in amplitude imaging, coherent data volume and phase for wide-/narrow-azimuth 3-D seismic exploration, the paper considered that the wide-azimuth seismic exploration has widespread application prospect in lithologic and directional fracture exploration.

**Key words:** wide azimuth, narrow azimuth, anisotropy, azimuth velocity, VTI anisotropy, HTI anisotropy

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**Deep 3-D seismic data acquisition techniques.** Zhang Xiuhong, Qiao Dajun and Tian Xinqi. *OGP*, 2003, 38(4): 358~362

Combining the real condition of deep seismic exploration in Dongpu depression and aiming at the characters of fast attenuation, low frequency and weak energy of deep seismic signal, the paper discussed main method and some key techniques of deep 3-D seismic exploration and also discussed in detail the problems should be considered and the measures should be taken in deep seismic exploration. By taking these measures, the deep 3-D seismic exploration in Qianli'yuan region, Dongpu depression has been carried out, and the signal-to-noise ratio and resolution of seismic data has been greatly improved.

**Key words:** Deep 3-D seismic exploration, ghost, noise suppression, coupling, integration of seismic and VSP, super-bin processing, weak signal protection

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**Numerical simulation of air-gun array wavelet.** Chen Haolin, Ning Shunian, Xiong Jinliang, Wang Changchun and Guo Jian. *OGP*, 2003, 38(4): 363~368

As a source, the air-gun array has many advantages and has been used in marine seismic exploration for a long time. The theoretical study of air-gun is rare at home and the importance of air-gun is lack of knowledge. The paper probed the theoretical models of single gun for several major air-guns abroad, deeply studied coherent characters of air-gun at the same time, presented the algorithm of air-gun array wavelet. The tests has been done in comparison with real field data, which showed that the modeled results are more close to the actual data.

**Key words:** free bubble oscillation, air-gun, air-gun array, wavelet, theoretical model

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**2-D seismic data acquisition in Hefei basin.** Feng Gang, Zhang Guangde, Hu Lixin and Zheng Zeji. *OGP*, 2003, 38(4): 369~374

The Hefei basin puts all kinds of complex topography together such as mountains, hills, plains, marshes and network of rivers etc. ; Lower Velocity Layer (LVL) has rapid changes both in thickness and velocity; bed-dips are variable; weak reflection from interface and strong noise interference made data poor signal-to-noise ratio. We adopted the following measures in seismic field operation in Hefei basin in view of the surface condition: designing of geometry with high folds, long offset and small group interval; using satellite photo and in combination with geologic outcrop investigation data for reasonable selection of shooting and receiving conditions and adjustment of geometry in time; adopting the charge with high-explosive-speed to shot etc. The resulted data has obvious improvement in comparison with legacy data and ideal effects.

**Key words:** Hefei basin, seismic acquisition, satellite photo, data quality

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**Background velocity replacement and reconstruction of velocity field by wavefield continuation.** Cui Xingfu and Zhang Guanquan. *OGP*, 2003, 38(4): 375~380, 404

In common midpoint-half-offset domain, utilizing prestack double-square-root operator of wave equation to realize downward continuation for shot and receiver layer by layer, through using replacement velocity to replace overlaying strata velocity and eliminate the impact of background velocity on strata imaging, resulted in improving the processing quality of deep seismic data. Through downward continuation of wavefield at shot and receiver points by prestack double-square-root operator and stripping layer by layer, we can do precise velocity analysis to eliminate the influence of overlying strata on velocity and to reconstruct velocity field, so that the precision of velocity analysis can be improved, that provides a reliable velocity analysis means for prestack migration imaging.

**Key words:** prestack double-square-root operator, background velocity replacement, wavefield extrapolation, velocity field rebuilding

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**Network-based seismic data processing: from cluster computing to grid computing.** Wang Honglin. *OGP*, 2003, 38(4): 381~386

Network-based seismic data processing system faced a new technical leap along with continuous development of computer information technique and further merging computation with network technique.

The cluster computing rapid developed in application of seismic data processing in recent years is network-based computing technique, having played important role in high-precise seismic imaging. Client /server computing mode gradually popularized at present is developing in the direction of Internet seismic data processing. The grid computing under probing can fulfill sharing long-range data and computing resources and team cooperation work, producing revolutionary and profound impact on future seismic data processing and is helpful to improve work flow of oil-gas exploration.

**Key words:** seismic data processing, cluster computing, client/server computing, grid computing, Internet seismic data processing

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**Radon projection 3-D prestack time migration.** Huang Xinwu, Wu Lü and Song Wei. *OGP*, 2003, 38(4): 387~391

The final object of seismic exploration is correct imaging for sub-surface geologic structures. It brings a lot of difficulties to 3-D seismic data processing, for 3-D seismic data acquisition can't be carried out in direction perpendicular to structural trend. The paper made application of 3-D poststack Radon projection migration to 3-D prestack processing and presented projection 3-D prestack migration algorithm. Using the principle of Radon projection, the method projected 3-D prestack data volume onto a different radial direction, the structure in each azimuth are involved in certain or multiple radial section, forming a series of independent 2-D prestack lines, which can be processed by common 2-D prestack time migration, then, the reverse projection on time slice was applied to get final 3-D prestack time migration data volume. Real data ap-

plication showed that using the method for 3-D prestack time migration resulted in obvious improvement of signal-to-noise ratio of the sections with weak reflection from boundary and good image for middle and deep horizons.

**Key words:** seismic migration, Radon projection, radial section, inverse projection

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**Inversion of poststack time-lapse seismic data by modified simulated annealing algorithm.** Li Jingye and Chen Xiaohong. *OGP*, 2003, 38(4): 392~395

Based on generalized Boltzman-Gibbs statistical theory, the paper adopted a new disturbed model produced by temperature-dependent pseudo-Cauchy distribution. Choosing modified acceptance probability formula and setting memory in practical computation, the best results can be searched out by memory and the simulated annealing algorithm suitable for inversion of time-lapse seismic data can be acquired. Through analysis of relations between seismic data and models, we chose proper objective function and flow for inversion of time-lapse seismic data and achieved good results through theoretical models tests. The new inversion algorithm has better anti-noise ability, good stability and high-precision for inversion results, better finishing the inversion for small impedance changes in time-lapse seismic data.

**Key words:** simulated annealing algorithm, inversion, time-lapse seismic, objective function, memory

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**Acquiring interval velocity by joint inversion of travel-time and wave impedance.** Zou Qiang, Zhou Xixiang and Zhong Benshan. *OGP*, 2003, 38(4): 396~399

Interval velocity is very important parameter, but it's hard to be accurately acquired. In many cases, traditional Dix formula hardly meets the requirement of precision in current exploration. Although the precision of interval velocity computed by currently developed prestack travel-time inversion and wave impedance inversion of poststack seismic traces has been greatly improved, but it has

larger limitation when each method is used alone. The former has lower precision when it is used for thin-layer, that means, it is difficult to accurately compute the frequently varied interval velocity; on the other hand, the latter easily causes the entirety excursion, i. e. the slowly varied interval velocity is not under control. Therefore, the paper studied on prestack and poststack joint inversion and used genetic algorithm to improve the precision in poststack wave impedance inversion. It is showed from test results of both theoretic data and real field data that the method has good effects.

**Key words:** interval velocity, travel-time inversion, wave-impedance inversion

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**Prediction of micro-fractures in reservoir.** Liang Bing and Wang Huandi. *OGP*, 2003, 38(4): 400~404

Appreciation and prediction of micro-fractures in reservoir and verifying their distribution are important contents of integrative reservoir appreciation for micro-fractured reservoirs. Starting from analyzing the theory of plane stress field, the paper introduced mechanical mode for simple fold and composite structural mode and analyzed the theory of structural fracture. On that basis, the paper computed plane stress field. According to distribution and direction of major, minor principle stress and shear stress, the theoretical development for longitudinal, transverse and shear tensile fractures of paleo-structure and new-structure and its extension can be analyzed. The method was applied in W2 fault block which gained a good result.

**Key words:** reservoir, micro-fracture, prediction, stress

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**Lateral prediction of complex oil-gas reservoir.** Zhu Qingzhong, Huang Handong, Wei Xiucheng, Ye Lianchi and Mao Zhigang. *OGP*, 2003, 38(4): 405~408

Daxing conglomerate is a very typical complex oil-gas reservoir in north China. The reservoir not only is lateral variable, but also has strong inhomogeneity within the rock body. Based on the relation

between velocity and lithology and between time and depth, the paper adopted the non-linear seismic inversion, inverted the precision reservoir thickness under the constraint of lithology measured by logging data, computed the variation of target (conglomerate) thickness in a plane and looked for such conglomerate reservoirs that have huge sedimentary thickness and stable distribution. The practical prediction showed that the method for lateral prediction of reservoir presented by the paper has importance to rolling exploration of Daxing conglomerate reservoir.

**Key words:** complex oil-gas reservoir, seismic record, constrained inversion, conglomerate, reservoir prediction

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**Dynamic stress-strain response in saturated rocks under cycling load.** Chen Yunping, Xi Daoying and Xue Yanwei. *OGP*, 2003, 38(4): 409~413

Through cycling loading experiment for saturated sandstone and marble and studying the subtle difference in their stress-strain curves, the paper pointed out that the hysteresis loops of stress-strain has different shapes for rocks with different characters and saturated with various pore-fluids. These differences are caused by different responses of strain on stress when rocks are under cycling load, which the phases of strain may be leading, lacking and lagging of stress phases in loading stage. The paper introduced Preisach-Mayergoyz model (simplified as PM model) to simulate the phenomenon. Through constitution of PM space density function, the stress-strain state equation for saturated rocks has been defined and the hysteresis loops of axial stress-radial stress has been simulated. The simulated results showed that the different density function in PM space reflects in some degree that the saturated rocks have the different character of relation response under function of seismic wave load.

**Key words:** hysteresis loop, cycling load, Preisach-Mayergoyz model, saturated rock, stress, strain, response

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**Discussion on near-surface characters and struc-**

**tures in complex area of western China.** Xia Zhu, Zhang Shaohua and Wang Xuejun. *OGP*, 2003, 38(4): 414~424

The paper systematically divided, classified and described all kinds of complex near-surface characters and structures in western China from geologic point of view. On the one hand, we try to analyze, summarize and discuss that the complex near-surface brings negative impacts on seismic exploration; on the other hand, we want to provide necessary helps for the next field operation in complex area and how to adopt effective seismic technology.

**Key words:** complex area, near-surface character, near-surface structure, influence on seismic exploration

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**Contributing factor of sandstone fracture and its integrated identifying technology for regular logging data.** Zhou Cancan and Yang Chunding. *OGP*, 2003, 38(4): 425~430

The emergence of fractures in sandstone mainly resulted from more rigid component in sandstone, small rock grain and porosity and more dense lithology. The paper described in detail the response of regular logging data to fractured sandstone, presented enhancing displaying methods for regular logging data such as micro-spherical focusing impedance variation and deep lateral and micro-spherical focusing impedance difference and integrated identifying fracture by BP neural networks for regular logging data. The practical data processing showed that integrative use of these methods can greatly improve the identification of fractures in sandstone.

**Key words:** conventional logging, fractured sandstone, recognition, integration

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**Using multi-wave data to detect fractures.** Zhang Xiaobin, Li Yalin, Tang Jianhou, Yang Huizhu and Liu Yang. *OGP*, 2003, 38(4): 431~434, 438

The paper presented a method for detecting fracture by multi-component technique. The S-wave splitting characteristics caused by upgoing

converted S-wave transmitting fracture medium are used to study fracture property. The fracture orientation is detected by rotation analysis. The fracture intensity is detected using methods of NMO velocity analysis, vertical velocity analysis of P- and S-wave and rotation analysis. The real data processing of LYS structure in Sichuan losin reveal that fracture detection with multi-component data is effective and highly practical tool

**Key words:** multi-wave, fracture orientation, fracture density, rotation analysis, NMO velocity, Sichuan basin

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#### **Non-linear constrained inversion of seismic data.**

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Non-linear inversion has more advantages over linear inversion in aspects of solution space's property and state for studying the reservoir with complex wave. Based on non-linear optimal theory, the paper presented a method for non-linear inversion of seismic data under structural-logging constrain, which integrated advantages of such linear inversions as logging-constrained inversion and broadband-constrained inversion. The processing results of real seismic data showed that the method has advantages of fast computation, stable and high precision, which has good applied prospect in oil-gas reservoir studying.

**Key words:** non-linear, constrained inversion, seismic data, logging, structure

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#### **Effect of pole-pole potential error on apparent resistivity.** **Wu Xiaoping, Xu Hailang, Wan Xin and Wang Tongtong.** *OGP*, 2003, 38(4): 439~443

Pole-pole electrical potential can be transformed to apparent resistivity of any electrode arrangement by linear combination. However, it is impossible to avoid introducing noises into electrical potential in field survey and numerical forward

modeling, which will cause uncertainty for apparent resistivity. In this paper, we discuss the effects of random potential error and error resulted from the numerical computation of 3-D finite-difference modeling on the apparent resistivity. The results show that even modest levels of noise in the pole-pole potential will cause big uncertainty for the apparent resistivity of dipole-dipole array, but the error in the apparent resistivity of symmetrical quadrupole array is not very large. The potential error resulted from the numerical computation also has uncertainty for the apparent resistivity to a certain extent. The points of view in the paper have been proved by the results of error analysis.

**Key words:** apparent resistivity, pole-pole, symmetrical quadrupole, dipole-dipole, potential, 3-D finite-difference numerical modeling

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#### **Transform from transient electro-magnetic (TEM) electric section into pseudo-seismic section.** **Xue Guoqiang and Li Xiu.** *OGP*, 2003, 38(4): 444~446, 459

In order to realize accurate interpretation of TEM sounding data, the idea of pseudo-seismic section transformation for TEM data produced by loop-source had been presented in the paper. The mathematical model was given in a condition of horizontal layered medium, the transform method and processing procedure have been put forward; the secondary induced voltage data measured in field, after Fourier transform, was used to compute the wave-impedance by using linear numeric filtering in frequency domain; then after inverse Fourier transform, the reflection coefficient sequence  $q_m$  of TEM field has been computed by linear programming in time-domain, and finally the pseudo-seismic section has been plotted by parameter  $q_m$ . The results showed that the method is effective.

**Key words:** loop-source, transient electro-magnetic, electric section, pseudo-seismic section, transform, reflection coefficient

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