

## ABSTRACTS

**Raytracing in TTI media using wavefront construction.** Bai Hai-jun<sup>1,2</sup>, Sun Zan-dong<sup>1</sup> and Wang Xue-jun<sup>3</sup>. *OGP*, 2011, 46(Supplement 1): 1~6

The direction of ray (group velocity) and that of traveltimes gradient (phase velocity) are not the same, making raytracing in TTI media rather difficult. The traditional raytracing system formulated in terms of elastic parameters in the anisotropy is more complicated than that in the isotropic case. Furthermore, an eigenvalue problem for polarization vectors has to be solved at every ray step. As a result, raytracing in TTI media is always time consuming. Considering all the difficulties mentioned above, a kind of raytracing system formulated in terms of phase velocity and group velocity, which is similar to the expressions for isotropic media, is introduced in this paper and raytracing in TTI media is largely simplified consequently. After a comprehensive consideration for many travel-time calculation algorithms, the wavefront construction method is chosen to trace rays and propagate wavefront. By combination of simplified raytracing system and the merits of wavefront construction method, a simple and efficient method for raytracing in TTI media is realized and several numerical models are used to demonstrate its feasibility.

**Key words:** TTI media, raytracing, raytracing system, wavefront construction method

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**Kirchhoff prestack depth  $Q$ -migration and application in Tarim carbonate reservoirs.** Bai Ying-zhe<sup>1,2</sup>, Sun Zan-dong<sup>1,2</sup> and Zhou Xin-yuan<sup>3</sup>. *OGP*, 2011, 46(Supplement 1): 7~11

The fractured and caved carbonate reservoirs

in Tarim Basin are buried below depth of 5000m. Because the surface of desert is very loose, the energy of seismic wave suffers serious absorption. Hence the characteristics of seismic signal recorded in these areas always show weak energy, low frequency and phase distortion. It is very important to consider these effects when imaging. To solve the problem above, a Kirchhoff  $Q$ -migration method is developed and presented in this paper. Firstly, the theory of  $Q$ -migration is introduced. Then a numerical model is tested to prove the applicability of this method. Finally, both  $Q$ -migration and traditional Kirchhoff migration are implemented to a VSP field data of Well LG38 in Tarim Basin. The results show that our Kirchhoff  $Q$ -migration method is better in imaging than the traditional one.

**Key words:** amplitude-preserved migration, viscoelastic media,  $Q$  compensation

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**VSP velocity extraction using wave field extrapolation.** Sun Zan-dong<sup>1</sup>, Xie Chun-hui<sup>1,2</sup>, Hao Hui-min<sup>3</sup> and Yong Xue-shan<sup>2</sup>. *OGP*, 2011, 46(Supplement 1): 12~16

We extrapolate the sources of VSP common receiver gathers to the same level as receivers by phase shift algorithm. The gathers after extrapolating is similar with the surface seismic data, then the root mean square velocity of layers below the receivers can be extracted using stack velocity analysis. Finally we figure out the interval velocity. This method solves the limit that the VSP travel-time inversion can only calculate interval velocity of layers between the receivers. Applying this

method in Lungu 38 field VSP data, we obtain the 3D velocity volume for zone of interest.

**Key words:** VSP velocity analysis, wave field extrapolation, 3D velocity volume

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**Method and application of VSP anisotropic vector wavefiled decomposition.** Sun Zan-dong<sup>1,2</sup>, Li Qiang<sup>1,2</sup>, Sun Wen-bo<sup>1,2</sup> and Bai Hai-jun<sup>1,2</sup>. *OGP*, 2011, 46(Supplement 1):17~26

This paper introduces a vector wave field separation method for 3D 3C VSP data which is under anisotropic hypothesis. Using the common shot 3C data rotated once, the anisotropic Thomsen's parameters at the downhole receivers are inverted by using a nonlinear SQP method. After computing propagation angle, slowness and polarization vectors for each plane wave (upgoing P, downgoing P, upgoing S and downgoing S wave), a regularized generalized inverse algorithm in frequency domain is applied to determine the Fourier plane-wave amplitudes. Wave filed separation in time domain is realized by inverse Fourier transform. The feasibility and stability of the method is proven by application to two forward modeled VSP data and one field zero-offset 3C VSP data. Additionally, the superiority of this algorithm is shown by comparison of this algorithm with the isotropic vector inversion method.

**Key words:** VSP, wavefiled separation, SQP, anisotropy, Thomsen parameters, slowness

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**Comparison and analysis of scalar wavefield separation in VSP processing.** Zhang Da-wei<sup>1,2</sup>, Sun Zan-dong<sup>1,3</sup>, Wang Xue-jun<sup>2</sup>, Zou Wen<sup>2</sup>, Guo Shuang-sheng<sup>4</sup> and Zheng Qiang<sup>5</sup>. *OGP*, 2011, 46 (Supplement 1):27~33

In this paper, we make a detailed description of the principle and applied condition of the wave-by-wave wavefield separation method, and make a short introduction of the principles as well as advantages and disadvantages of the commonly used methods— $f$ - $k$  filtering, median filtering and mean filtering. By using these four methods separately in the nearly zero offset VSP data, land 3D VSP data and ocean 3D VSP data, we make a comparison and finally get a conclusion that the wave-by-wave method is better than the others.

**Key words:** wave-field separation,  $f$ - $k$  filter, median filter, mean filter, wave-by-wave wavefield separation

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**Constant gradient ray tracing algorithm and its application on VSP-CDP mapping.** Cai Lu-lu<sup>1</sup>, Sun Zan-dong<sup>1,2</sup>, Bai Hai-jun<sup>1</sup> and Hao Hui-min<sup>3</sup>. *OGP*, 2011, 46(Supplement 1):34~39

Among different ray tracing methods, the constant gradient algorithm proposed by Langan R. T et al. (1985) is considered to be both accurate and highly efficient, where the model is discretized into rectangular cells characterized with a constant velocity gradient. For a certain grid, ray exit position, orientation and traveltime are computed based on the position and orientation of the ray at entry point. This method can not only trace rays through medium with arbitrary velocity distri-

bution, but also ensure higher accuracy and efficiency. Reflected wave ray tracing using this algorithm is discussed in this paper, where the two-point problem is solved by combination of step-search method and linear interpolation. Then VSP-CDP mapping based on this method is implemented for both numerical modeled and field VSP data.

**Key words:** ray tracing, constant gradient, two-point ray tracing, VSP-CDP mapping

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**Travel-time inversion using VSP multi-wavefield.** Xie Chun-hui<sup>1,2</sup>, Sun Zan-dong<sup>1</sup>, Wang Xue-jun<sup>3</sup> and Yang Wu-yang<sup>2</sup>. *OGP*, 2011, 46(Supplement 1): 40~46

On the basis of geometric seismic principle, this paper employs travel-time of VSP down-going P wave, up-going P-P wave and up-going P-S wave to calculate interval velocity. Down-going P wave travel time may get the interval velocity above the receivers. Up-going P-P wave travel time may get the interval velocity below the receivers. Up-going P-S wave travel time may get the S-wave interval velocity. Finally we obtain the 3D velocity volume velocity for the zone of interest using the first arrival travel-time inversion.

**Key words:** velocity analysis; travel-time inversion; multi-wavefield

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**Q-factor inversion and calculation using zero-offset VSP data.** Zhang Da-wei<sup>1,2</sup>, Sun Zan-dong<sup>1,3</sup> and Wang Xue-jun<sup>2</sup>, Zou Wen<sup>2</sup>, Feng Xiao-yan<sup>4</sup>, Lu Yao<sup>5</sup>. *OGP*, 2011, 46(Supplement 1): 47~52

Q-factor, which describes the seismic attenuation

and the viscoelasticity of the formation, is an important physical parameter depicting seismic wave propagation. Therefore, Q-factor plays a significant role in high resolution seismic prospecting. Spectral ratio method (SRM) and centroid frequency shift (CFS) method are the most popular. In this paper, the concepts of the two methods are introduced first. Then the feasibility is tested by synthetic data. The inversion results show that both the two methods perform well while there is no noise in the inputs. Finally, stability of the two methods is verified by noised synthetic data, synthetic data of full wavefield and field zero-offset VSP data respectively, the results suggest that CFS is more reliable than SRM.

**Key words:** Q-factor, VSP, Centroid frequency shift, spectral ratio method

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**Anisotropy analysis and parameters extraction on 3D VSP common receiver gathers.** Bai Hai-jun<sup>1,2</sup>, Sun Zan-dong<sup>1</sup> and Li Yan-peng<sup>3</sup>. *OGP*, 2011, 46(Supplement 1): 53~59

Anisotropy analysis and parameters extraction based on the nonhyperbolic moveout is discussed in this paper. The nonhyperbolic moveout, which is more accurate on long-spread, is derived under VTI hypothesis. The main idea is as follows: Firstly the feasibility of this method is demonstrated by synthetic data. Then, it is applied to a filed VSP data, where the anisotropy analysis including VTI and azimuth anisotropy is performed on 3D VSP common receiver gathers. Finally, extraction of interval anisotropy parameters from the effective parameters is discussed and tested on both model

and field VSP data. As a result, the data in this area shows strong VTI and some azimuthal anisotropy.

**Key words:** first break time, non-hyperbolic move-out, VTI, azimuthal anisotropy

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**Application of AVO technology to gas detection in Bengal Bay. Zuo Guo-ping<sup>1</sup>, Lv Fu-liang<sup>1</sup>, Fan Guo-zhang<sup>1</sup>, Shao Da-li<sup>1</sup> and Sun Hui<sup>1</sup>. *OGP*, 2011, 46(Supplement 1):60~66**

Sand bodies are rich in our study area of Bengal Bay. Most of them are offshore deepwater sedimentary channels and lobes. They represent high amplitude as bright spots, and lateral changes are fast. But not all of them contain hydrocarbon. Thus hydrocarbon detection is very important in the study area. The Aki & Richards equation and Shuey equation are applied in this paper. Series of pre-stack AVO attribute cubes are calculated based on these equations, such as P-wave velocity, S-wave velocity, P-wave impedance, S-wave impedance, intercept ( $P$ ), gradient ( $G$ ),  $P \times G$ , near offset stack amplitude, far offset stack amplitude, fluid factor, Poisson ratio and so on. The forward modeling, fluid substitution and petrophysical analysis with well data have been carried out. The corresponding amplitude characteristics are defined, and relevant AVO attributes are calculated, which serve as the basis for the later seismic AVO attribute analysis. The results of this research indicate that if a reservoir contains gas, the amplitude increases with offset, P-wave velocity, P-wave impedance,  $\lambda\rho$  and Poisson ratio all change fast. These features belong to AVO anomalies of type III. And if a reservoir contains water, the above attributes only show tiny changes. In this paper,  $P \times G$ , fluid factor, Poisson ratio, P-wave impedance and  $\lambda\rho$  are used for analysis. Many gas prospects have been detected in the study area based on this method.

**Key words:** hydrocarbon detection, AVO technology, AVO attribute cube, forward modeling, fluid

substitution, petrophysical analysis

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**Applications of EEI inversion in reservoir prediction. Niu Cong<sup>1</sup>, Liu Chun-cheng<sup>1</sup>, Liu Zhi-bin<sup>1</sup>, Zhang Yi-ming<sup>1</sup>, He Feng<sup>1</sup>, Wang Zhi-hong<sup>1</sup> and Xie Ji-gao<sup>1</sup>. *OGP*, 2011, 46(Supplement 1):67~71**

Extended elastic impedance inversion, a new technique combining of partial angle stack and P-wave, S-wave and density logging data in the realm of oil/gas exploration, can obtain more abundant elastic parameters associated with lithology and fluid for reservoir prediction and hydrocarbon detection. In this paper, a real case by this technique is introduced based on the concept and principle of the EEI, application conditions and the key steps are discussed. A field study of X area shows that EEI can discern gas sands and plot out the target area with high resolution and reliability.

**Key words:** EEI inversion, partial angle stack, elastic parameters, reservoir prediction, hydrocarbon detection

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**Spectrum decomposition application in thin-reservoir prediction in Changshaling belt, Yinger Depression. Sun Xue-dong<sup>1,2</sup>, Zhao Jian-ru<sup>2</sup>, Bai Jun<sup>2</sup>, Wang Ze-quan<sup>2</sup>, Yang Chang-you<sup>2</sup> and Qin Shu-hua<sup>2</sup>. *OGP*, 2011, 46(Supplement 1):72~75**

Spectral decomposition provides a novel means of utilizing seismic data and discrete Fourier transform (DFT) for imaging and mapping temporal bed thickness and geological discontinuities over large 3D seismic surveys. By transforming seismic data into frequency domain, processing and interpreting the tuning cube indicate lateral geologic discontinuities. This paper introduces reservoir prediction on upper Xiagou in Changshaling belt, Yinger depression with spectral decomposition. The frequency tuning range of thin sand is confirmed by tuning cube along the horizons. Delta sand body distribution and fan delta front sand body distribution are predicted to identify thin beds in practice and the predicted results coincide with the actual drilling data. Practical application results show spectral decomposition techniques are more accurate for thin sand bodies than the tradi-

tional full-band reservoir prediction.

**Key words:** spectral decomposition; tuning cube; common frequency data; thin sand body

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**Application of multi-wavelet decomposition to reservoir prediction in the north of South-Bel Depression.**

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Structures in the north of south-Bel depression are very complicated. Sand and shale are interbedded with contained tuffaceous sandstone and variant facies. Based on the reservoir characteristics, we first delineate sequence stratigraphy and interpret horizons, and then we predict reservoir and detect hydrocarbon based on components of wave pattern and spectrum attributes after multi-wavelet decomposition. Our study results have been proved.

**Key word:** multi-wavelet decomposition, reservoir prediction, characteristic of amplitude spectrum, component of wave pattern, seismic attenuation, hydrocarbon detection

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**Frequency-extension in oil sand prediction. Wu Yong<sup>1</sup>, Nie Kai-xuan<sup>2</sup>, Ren Jin-li<sup>3</sup>, Qin Jian-xun<sup>1</sup>, Li Ai-jun<sup>1</sup>, Wang Jian-zhu<sup>1</sup> and Li Yan-xin<sup>1</sup>. *OGP*, 2011, 46(Supplement 1): 80~83**

The seismic frequency-extension technology studies thin-layer changes in small time window from spectrum analysis. Reservoir lateral changes in frequency domain are found by tuning amplitude or phase, and different scale geo-bodies are identified by response characteristics of different frequencies. This technology can help us identify thin layer with thickness less than 1/4 wavelength. We extract a few seismic attributes, including instantaneous frequency, instantaneous phase, root-mean-square amplitude, phase cosine and so on. Our study shows that the frequency-extension attributes are very sensitive to main oil sands, especially to thickness changes of oil sands of Shahejie

formation between Wells BS6 -BS8. And our predictions match well with the results of the new drilled Wells B35, B38, B39, and B27.

**Key words:** thin-layer, lithologic trap, characteristics of seismic attribute, frequency domain, frequency-extension technology

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**Reservoir prediction of Minghuazhen formation in the 4th structure zone, Nanpu. Zhang Jun-yong<sup>1</sup>, He Jing-bo<sup>1</sup>, Liu Liang-qiong<sup>1</sup>, Zhang Xiao-long<sup>2</sup>, Ma Hui<sup>1</sup> and Tang Jian-chao<sup>1</sup>. *OGP*, 2011, 46 (Supplement 1): 84~87**

Belonged to fluvial facies deposition, thin reservoirs of Minghuazhen formation in the 4th structure zone of Nanpu, are vertically superimposed with rapid lateral variance. From geologic and geophysical characteristics of Minghuazhen formation in the 4th structure zone, we investigate regional sedimentary features by seismic attributes, qualitatively predict sand bodies of meandering river by spectrum decomposition, predict the favorable reservoirs distribution by lithologic indicator simulation, and carried on oil and gas detection combining with drilling and logging data. According to our results of reservoir prediction, two wells deployed got good oil gas show.

**Key words:** reservoir prediction, spectrum decomposition, lithologic indicator simulation, fine structure interpretation, oil and gas detection

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**Identification of near-shore subaqueous fans in Es<sub>4</sub>, Xingxi sub-sag. Yu Lin<sup>1</sup>, Du Ying-jie<sup>1</sup>, Xiang Sheng<sup>1</sup>, Chen Hong<sup>1</sup>, Zhu Xiao-xi<sup>1</sup>, Xie Liang<sup>1</sup>, Zhu Hong<sup>1</sup> and Liu Hua<sup>1</sup>. *OGP*, 2011, 46(Supplement 1): 88~91**

Xingxi sub-sag in middle of western sag of Li-

aohe Basin is a narrow and long sedimentary sub-sag. It was considered that the 4th member of Shahejie Formation was not well developed in the region. Based on the comparison of seismic strata of Xingxi sub-sag, we see the 4th member of Shahejie Formation as the most favorable reservoir in the area. By comprehensive analysis of regional tectonic background and sedimentary characteristics, we conclude that there are coastal sedimentary fan bodies controlled by east fault zone. We predict and delineate a series of near-shore submarine fan reservoirs with various geophysical techniques. Well XX2 in this area, with commercial oil discovery, reveals the existence of sedimentary fan bodies in the 4th member of Shahejie Formation.

**Key words:** near-shore subaqueous fan, reservoir prediction, the 4th member of Shahejie Formation, Xingxi sub-sag

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**Identification of channels by multi-attributes in Nanbaxian.** Cao Zhe<sup>1</sup>, Chen Hai-qing<sup>1</sup>, Shen Ya<sup>1</sup>, Qi Cheng-ye<sup>1</sup>, Ji Yuan<sup>1</sup> and Qu Yan-wei<sup>1</sup>. *OGP*, 2011, 46(Supplement 1): 92~96

This paper focuses on identification of channels by multi-attributes in the north slope of Nanbaxian, north part of Qaidam Basin. After studying geological and geophysical features of the area, we use seismic attributes, spectral decomposition, Sobel filter similarity, energy ratio similarity, coherence and 3-D visualization to identify the distribution of channel sand bodies in  $N_2^1$ . Meanwhile we analyze features and results by different approaches. The results show that channel sand bodies in the north slope of Nanbaxian were developed, and that they distribute from southeast to northwest. The area may be prospective with lithologic traps.

**Key words:** reservoir prediction, seismic attributes, underwater split-flow channel, spectral decomposition, Sobel filter similarity, energy ratio similarity, 3-D visualization

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**Hypothesized 3D seismic application in oil exploration of Suibin Depression.** Wang Peng<sup>1</sup>, Zhong Jian-hua<sup>2,3</sup>, Zhang Bao-quan<sup>1</sup>, Zhang Hong-wei<sup>1</sup>, An Peng and Wang Yu-shan<sup>1</sup>. *OGP*, 2011, 46(Supplement 1): 97~101

Hypothesized 3D seismic volume is established based on all the 2D survey lines of the work area. By hypothesized 3D seismic volume in Suibin Depression, Sanjiang Basin, we carry out seismic inversion, and draw a mudstone thickness chart. Based on a contrastive analysis with seismic facies, a clearer hydrocarbon source rock distribution is obtained, which can provide more reliable information for the future exploration. Results show that hypothesized 3D seismic technology may play an important role of the exploration in the area which only has 2D seismic data.

**Key words:** hypothesized 3D seismic, seismic inversion, reservoir prediction, hydrocarbon source rock, sedimentary face, Suibin Depression

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**Prediction of heterogeneity in carbonate reservoirs: an Hexiwu example in North China.** Han Tian-bao<sup>1</sup>, Cheng Peng<sup>1</sup>, Wang Yong-li<sup>1</sup>, Zhang Jing-dong<sup>1</sup> and Fang Hai-fei<sup>1</sup>. *OGP*, 2011, 46(Supplement 1): 102~105

Buried hill reservoirs of Hexiwu structure belt of Langgu sag in Jizhong Depression, which had been discovered and proved, are Paleozoic Ordovician carbonate reservoirs with many caves and fissures. They have the following characteristics: strong heterogeneity, lateral variation in properties. The fissures are the most important predominant. So fracture prediction plays a vital role on accumulation conditions analysis and prediction of hill reservoirs in this area. Based on multi-attributes, such as coherent data, body curvature data, amplitude and frequency from new 3D seismic data,

we predict and characterize the spatial distribution of reservoir's caves and fissures, and delineate favorable zones for development in the central north of Hexiwu structure belt. The drilling results show that the carbonate reservoirs developed many fissures with good hydrocarbon show, and that confirms our study is successful.

**Key words:** reservoir prediction, carbonate rock, heterogeneity, fissures, body curvature

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**Seismic interpretation of development area with high density wells in Daqing.** Li Peng<sup>1</sup>, Qian Li-ping<sup>1</sup>, Shi Qiao<sup>1</sup> and Li Xing-yun<sup>1</sup>. *OGP*, 2011, 46 (Supplement 1): 106~110

After four time infilling adjustments in SN Block of Daqing Oil Field, currently well density has reached 53 wells/km<sup>2</sup>. But some difficulties still remained, such as sand distribution relationship between wells is unclear, micro-relief structures between wells cannot be characterized, and so on. According to the special geological condition and actual data, multiple methods are adopted such as geological statistical association simulation, ant tracking method and 3D curvature properties to study in the oil-water transition zone in the test area. SP association simulation technique was optimized to identify one-meter thickness reservoir. Micro-relief structures between wells could be reflected by curvature properties and ant-tracking attribute jointing wells information can identify subtle fault features. Application of these multi-methods can identify micro-faults and micro-structures, and subtle reservoirs.

**Key words:** micro-relief structures between wells, curvature properties, prediction of sand distribution between wells, waveform classification, ant-tracking method

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**Litho-stratal trap identification and distribution in Shichang sub-sag, Nanpu Sag.** Yang Yu<sup>1</sup>, Zhao Xi-qi<sup>1</sup>, Wang Zi-ying<sup>1</sup>, Tian Shuang<sup>1</sup> and Xu Pan<sup>1</sup>. *OGP*, 2011, 46 (Supplement 1): 111~116

It is difficult to find more structure traps bigger than 1 km<sup>2</sup> in Shichang sub-sag. So finding litho-

stratal traps may be the focus of exploration in the future. Combining with the theory of stratigraphy, structure geology and sedimentology, through delicate structure and generalized depositional interpretation, we put forward in this paper a new observation that the downthrow side of Baigezhuang fault is intermittently subsided, and the counterpart of Xinanzhuang fault is continuously subsided. We also point out a rule that more litho-stratal traps develop in the active downthrow side than the stable one and the oil pool scale is larger in the former one. So it is the favorable petroleum exploration zone. In this article, we divide Shichang sub-depression into seven different types of litho-stratal traps development area for the first time. This will provide help for the litho-stratal traps exploration.

**Key words:** Shichang sub-sag, litho-stratal trap, seismic stratigraphy, sequence stratigraphy

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**Micro-fault interpretation by multiple attributes.** Ji Xue-wu<sup>1,2</sup>, Peng Xin<sup>2</sup>, Zang Dian-guang<sup>2</sup>, Zhang Yan-qing<sup>2</sup>, Nie Gang<sup>2</sup>, Xu Bao-liang<sup>2</sup> and Huang Chuan-li<sup>2</sup>. *OGP*, 2011, 46 (Supplement 1): 117~120

In Jiulongshan area of Sichuan Basin, the gas reservoirs of conglomerate section in Jurassic Zhenzhuchong formation are structural-lithologic, controlled by structure, reservoir, fracture, and other factors. Due to seismic data quality, micro-fault cannot be subtly depicted by traditional ways on seismic sections and conventional coherence slices. With structure-oriented filter, we use spectrum decomposition, new generation coherence slices and volumetric curvature technology to subtly depict spatial distributions of micro-faults. The results indicate that multiple attribute method is reliable for the micro-fault interpretation, and volumetric curvature attribute is more effective for micro-fault delineation.

**Key words:** Sichuan Basin, conglomerate section in Jurassic, Zhenzhuchong formation, micro-fault, structure-oriented filter, coherence, spectrum decomposition, volumetric curvature

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**Evaluation of carbonate reservoirs by frequency-spectrum integration attributes.** Dai Shuang-he<sup>1</sup>, Yu Jing-bo<sup>2</sup>, Yuan Yun-chao<sup>2</sup>, Mao Feng-jun<sup>3</sup> and Chen Zhi-gang<sup>2</sup>. *OGP*, 2011, 46(Supplement 1): 121~127

Within thin carbonate reservoir, there is dual medium feature of both fracture-caves and matrix reservoir space in the North Teruwa Field of the eastern fringe of Caspian middle block. There are tiny difference of seismic attributes (amplitude and impedance, etc) between reservoir and non-reservoir, and the difference is evident between actual drilled results and the high-production zones predicted by multiple attributes analysis. In this paper, carbonate reservoirs are evaluated with frequency-spectrum integration. When seismic waves pass fluid-bearing reservoirs, there will be a dynamic feature of 'cooscillation in low frequency and attenuation in high frequency'. In this paper, we show our prediction of high porosity and high permeability zones by storage space attribute and our prediction of high-production zones by the crossplot of mobile hydrocarbon porosity versus deliverability. Good results are acquired when the study conclusions were applied into directing the field exploration.

**Key words:** North Teruwa oilfield, dual medium reservoir, frequency-spectrum integration, mobile hydrocarbon porosity, storage space attribute, cooscillation in low frequency, attenuation in high frequency, high porosity and high permeability zone

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**Complex fault-block traps identification with structure-oriented filter.** Zhao Ming-zhang<sup>1,2</sup>, Fan Xue-hui<sup>3</sup>, Liu Chun-fang<sup>3</sup>, Yu Jing-bo<sup>3</sup>, Shi Cai-juan<sup>3</sup>, He Li-hong<sup>3</sup>, Chen Zhi-gang<sup>3</sup> and Song De-cai<sup>3</sup>. *OGP*, 2011, 46(Supplement 1): 128~133

Structure-oriented filter is a smooth operator

to seismic events that does not operate beyond event terminations. The purpose of the filter is to strengthen continuity of seismic events, to enhance the lateral resolution of the reflection terminations, and to save or improve the fault sharpness. Small faults could be highlighted by coherence attributes of seismic data after structure-oriented filtering. In this paper, structure-oriented filter is applied to seismic data in order to deal with developed faults, complex fault-blocks and complicated structures of Structure R in Bongor Basin. More than 30 small faults and 10 complex fault-blocks are identified through coherence volume analysis on the basis of the filtered data. Wells are deployed and good results are achieved.

**Key words:** structure-oriented filter, edge preserving, seismic coherence attribute, coherent volume, small fault, complex fault-block trap

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**Fault characteristics in Nanpu sag and their control of reservoirs.** Zhang Jun-yong<sup>1</sup>, Tang Jian-chao<sup>1</sup>, Ma Hui<sup>1</sup> and Chen cheng<sup>1</sup>. *OGP*, 2011, 46(Supplement 1): 134~138

Nanpu sag is located in the north of Huanghua Depression, Bohai Bay Basin. Influenced by multi-phase tectonic movements, the faults are well developed. In late Neogene, due to the structural reversion under EW direction weak compressive force in Napu sag, specific negative flower structure styles were formed. The faults are indentified by means of time and coherence cube slices, as well as curvature data, dynamic development data, logging well data. The fault styles in profile and in plane are summarized in this article. The characteristic of faults and their control of oil source, reservoir and traps are identified.

**Key words:** Nanpu sag, fault system, negative flower structure, hydrocarbon accumulation

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**Fracture characteristics in Qingxi Oilfield, Jiuquan Basin.** Sun Xing<sup>1,2</sup>, Pan Liang-yun<sup>1</sup>, Yan Qun<sup>1</sup>, Zhao Jian-ru<sup>1</sup>, Wei Jun<sup>3</sup> and Fang Chen<sup>3</sup>. *OGP*, 2011, 46(Supplement 1):139~143

From the core and logging data, in this article fracture types and microscopic features are analyzed in Qingxi Oilfield, Jiuquan Basin. Fracture distributions and their relation with geological structure are discussed based on regional tectonic background by seismic attributes, drilling and log data. The following observations are obtained. 1. Massive sandstone and argillaceous dolomite in the Xiagou of lower Cretaceous are typical low porosity and low permeability reservoirs. Fractures are major hydrocarbon pore volumes and migration pathways. Various types of tectonic fractures are developed, but the high angle fracture and oblique fractures are the most effective to oil and gas accumulation. 2. Faults control the fracture development direction. The direction of fracture development belt and that of fault development belt are basically same, mainly to the NNE and NWW. 3. The position of tectonic transition and fault intersection is a center of tectonic stress concentration and fracture development. 4. Crack growth controls oil and gas enrichment. The crack belt of NNE adjusting faults is an oil and gas enrichment zone. Using fracture prediction result, the newly defined Well L104 acquires high-productive oil flow with 64m<sup>3</sup> per-day.

**Key words:** Jiuquan Basin, Qingxi Oilfield, fracture characteristic, fault distribution, seismic attribute, hydrocarbon accumulation regularity

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**Study of correlationship between mass transport deposits and the dissociation of gas hydrate in Baiyun deepwater area.** Wang Zhi-jun<sup>1</sup>. *OGP*, 2011, 46(Supplement 1):144~150

Mass transport deposits (MTDs) are one kind

of deepwater sedimentary system driven by gravitation, which widely distributed in the global continental margins. Considering the important academic significance and engineering meaning, MTDs have become a focus of concern by scholars. Based on the multi-beam bathymetric data and high resolution seismic data in Baiyun sag, Pearl river basin, north of South China Sea, we identified large scale MTDs covering over 10,000km<sup>2</sup> on the seabed. As Baiyun large scale MTDs with typical structural units, sedimentary and structural features, the research and analysis are of theoretical and applied value. In order to clear further the correlationship between mass transport deposits and the dissociation of gas hydrate, we analysed mechanisms of gas hydrate dissociation and effects on the strength change of submarine sediments. We established geomechanical model and estimated the stability of submarine slope through ultimate equilibrium method. The results show that canyons on the north of Baiyun sag ensure abundant sediment supply while the dissociation of gas hydrate induced the development of MTDs.

**Key words:** Pearl River Mouth Basin, Baiyun sag, mass transport deposits, gas hydrate, deepwater area

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**Integrated modeling technology for complex fault belt in Qaidam Basin.** Zhang Ju-mei<sup>1</sup>, Cao Zheng-lin<sup>1</sup>, Zhang Dao-wei<sup>2</sup>, Qi Jia-fu<sup>3</sup> and Pei Ming-li<sup>1</sup>. *OGP*, 2011, 46(Supplement 1):151~154

Located in the east of Yingxiongling fault-fold belt, Yingdong area is the place with most developed surface structures of Qaidam Basin. Because of complex in both the surface and underground geological structures, quality of seismic data in Yingdong area is relatively poor, leading more difficulties in structure determination. Started from geological outcrops, drilling and tectonic evolution, an interpretation model of double structures (decoulement in the shallow and block-faulting in the deep) has been established by "integrated geological modeling technology" in this paper. Then, on the basis of synthetic seismogram combined

with velocity analysis, horizons have been calibrated by integrated calibration method of multi wells and multi levels. Finally, combination relations among fault systems of two stages and affection of later faults towards structures have been discussed according to generation mechanism. Based on newly interpreted results, Well S37 has been deployed in Yingdong area, with abundant oil/gas show, indicating a relatively bright application future of “integrated geological modeling technology” in seismic interpretation of complex area.

**Key words:** Qaidam Basin; complex structural belt; integrated geological modeling; balanced section; double structure model

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**Shale alteration calibration in shallow formations of Qikou depression.** Guo Shu-wen<sup>1</sup>, Xiao Dun-qing<sup>1</sup>, Fu Dong-li<sup>1</sup>, Wang Yu<sup>1</sup>, Zhai Li-jun<sup>2</sup>. *OGP*, 2011, 46(Supplement 1):155~158

Water base mud in Qikou depression invades shales in the shallow formation, which leads to shale alteration and errors in acoustic logs that cannot reflect velocities of origin formations. So synthetic seismogram calibration and well-constrain inversion cannot be accurate. Statistics show that shale velocity decreases with the soak time. After dividing the sand and shale profile, mean and variance methods can be used to calibrate shale alteration basing on short time soak well as a refer-

ence. Applications reveal that synthetic seismogram calibration and reservoir inversion of thin sands are better with shale alteration corrected acoustic log.

**Key words:** water base mud, shale alteration, environmental correction, synthetic seismogram, reservoir inversion

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**Applications of seismic SPS data.** Yue Yong-xia<sup>1</sup>, Yang You-hong<sup>2</sup> and Qu Ke-jiang<sup>2</sup>. *OGP*, 2011, 46(Supplement 1):159~162

China petroleum engineering technology production operation management system is one of the CNPC key projects in the “eleventh five-year plan”. According to the demand of CNPC, BGP formally put seismic exploration SPS data online operation in the system at the end of 2010. Information collection of the system mainly comes from seismic crews. Taking the advantages of data resources from seismic crews, we regularize data sources, reduce manual data input, improve field data utilization. This paper discusses seismic exploration SPS data application in the system.

**Key words:** CNPC engineering technology production operation management system, information collection, data sources, seismic exploration, SPS data

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