



1.

**Accession number:** 20200908220965

**Title:** Stimulation experiment of horizontal wells filled with permeable and water-blocking gravel in deepsea bottom-water gas reservoirs

**Title of translation:** 深海底水气藏水平井充填透气阻水砾石的增产实验

**Authors:** Liu, Yikun ; Wang, Haidong ; Meng, Wenbo ; Zhang, Chong ; Zhi, Jiqiang ; Shen, Anqi

**Author affiliation:** Key Laboratory of Ministry of Education of China on Enhanced Oil and Gas Recovery, Northeast Petroleum University, Daqing; Heilongjiang; 163318, China  
CNOOC China Limited Zhanjiang Branch, Zhanjiang; Guangdong; 524051, China

**Corresponding author:** Wang, Haidong (18249001311@163.com)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

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**Language:** Chinese

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**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to find an economic and effective water control method for horizontal wells in deepsea bottom-water gas reservoirs, we prepared modified coated gravel. And based on this, wear resistance, temperature resistance and water plugging capacity (WPC) tests were carried out on the coated gravel. Then, experiments were carried out using the 3D simulation device for the development of large-scale bottom-water gas reservoirs to compare the development effects of horizontal wells packed with

conventional gravel and coated gravel in deepsea bottom-water gas reservoirs. And the following research results were obtained. First, the upper limit of temperature resistance of the gravel coating is 240°C and the gravel packing speed can reach 4.48 m/s, which is 8 times the average flow velocity of gravel packing in actual open hole sections. Second, as the permeability of the coated gravel packing layer increases, its WPC gets weak. When the permeability is lower than 1 500 mD and the displacement pressure difference is lower than 0.6 MPa, the WPC of the coated gravel packing layer is between 0.17 and 0.68. Third, the coated gravel layer functions as gas permeability and water plugging, so the horizontal well technology with coated gravel packing can reduce the flow capacity of water phase breaking into the dominant flow passage, so as to delay the rise of water production of gas well and prolong the gas production time. In this way, the gas recovery factor of bottom-water gas reservoir can be increased effectively. In conclusion, this technology has the function of spontaneous selective water plugging, i.e., "water plugging in case of water and gas permeability in case of gas", and its technical and economic advantages are remarkable, which can provide a new idea for the water-control development of deepsea bottom-water gas reservoirs.

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**Number of references:** 18

**Main heading:** Gas permeability

**Controlled terms:** Coatings - Economic and social effects - Flow velocity - Gases - Gravel - Horizontal wells - Natural gas well production - Petroleum reservoir engineering - Petroleum reservoirs - Temperature control - Wear resistance - Well stimulation

**Uncontrolled terms:** Bottom water - Damage resistance - Deepsea - Development and stimulation - Gravel packing - Recovery factors - Water plugging

**Classification code:** 512 Petroleum and Related Deposits - 631 Fluid Flow - 731.3 Specific Variables Control - 813.2 Coating Materials - 931.2 Physical Properties of Gases, Liquids and Solids - 971 Social Sciences

**Numerical data indexing:** Pressure 6.00e+05Pa, Velocity 4.48e+00m/s

**DOI:** 10.3787/j.issn.1000-0976.2020.01.008

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2.

**Accession number:** 20200908220924

**Title:** Comparison and implications of ROP improvement technologies in typical high-pressure shale gas reservoirs in America and China

**Title of translation:** 中美典型高压页岩气藏钻井提速技术对比与启示

**Authors:** Qiao, Lihua ; Fan, Shenglin ; Qi, Yu

**Author affiliation:** Drilling & Production Engineering Technology Research Institute, CNPC Chuanqing Drilling Engineering Company Limited, Guanghan; Sichuan; 618300, China  
Drilling and Completion Technology R & D Department of National Energy shale gas R & D <Experiment> Center, Guanghan; Sichuan; 618300, China

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**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The Haynesville high-pressure shale gas reservoir in America and the high-pressure shale gas reservoir of Lower Silurian Longmaxi Formation in the Changning-Weiyuan national shale gas demonstration area in China are similar in geological and drilling conditions. The technical ideas for improving the rate of penetration (ROP) in the Haynesville high-pressure shale gas reservoir provide an important reference for the fast drilling of shale gas wells in China. In order to realize ROP improvement of shale gas reservoirs in China, this paper compares the ROP improvement technologies used in the typical high-pressure shale gas reservoir in China and in America, and analyzes and discusses the similarities and differences of ROP improvement technologies used in the Haynesville high-pressure shale gas reservoir in America and the high-pressure shale gas reservoir of Lower Silurian Longmaxi Formation in the Changning-Weiyuan national shale gas demonstration area in China. And the following research results were obtained. First, the hole size of the horizontal section in the Haynesville high-pressure shale gas reservoir is currently reduced from 215.9 mm to 171.5 mm or

161.1 mm, the single-well drilling investment is decreased by over 25%, showing an obvious advantage in energy conservation and emission reduction. Second, it is worthywhile for China to pay attention to, refer to, research and apply the ROP improvement technology of "efficient drilling bit + support downhole ROP improvement tool + drilling parameter optimization software/equipment" for high-abrasivity hard-to-drill formations used by American counterparts. Third, the drilling technology of "managed pressure drilling + density reduction" can play an important role in improving the ROP in high-pressure shale intervals. In conclusion, it is necessary to actively carry out exploratory tests on the reduced hole structure size and the application of related support drilling equipment, tool and software in the national shale gas demonstration areas of China, and explore, optimize and apply the managed pressure drilling technology continuously in the target intervals.

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**Number of references:** 23

**Main heading:** Reservoir management

**Controlled terms:** Application programs - Boreholes - Demonstrations - Drilling equipment - Drills - Emission control - Gases - Horizontal wells - Infill drilling - Investments - Shale gas - Software testing - Well drilling

**Uncontrolled terms:** Changning-Weiyuan national shale gas demonstration area - Drill formations - Gas reservoir - Hole structures - Managed Pressure Drilling - ROP improvement - Technological comparison

**Classification code:** 451.2 Air Pollution Control - 511.1 Oil Field Production Operations - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 603.2 Machine Tool Accessories - 723 Computer Software, Data Handling and Applications - 723.5 Computer Applications

**Numerical data indexing:** Percentage 2.50e+01%, Size 1.61e-01m, Size 2.16e-01m to 1.72e-01m

**DOI:** 10.3787/j.issn.1000-0976.2020.01.014

**Database:** Compendex

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3.

**Accession number:** 20200908220926

**Title:** Application of fishing coiled tubing by using coiled tubing in gas wells with low pressures and low production rates

**Title of translation:** 连续油管打捞连续油管工艺在低压低产气井中的应用

**Authors:** Pang, Dexin ; Abulimiti, Aibaibu ; Zhu, Zhaozhao ; Guo, Xinwei ; Yang, Wenxin ; Hao, Libo

**Author affiliation:** PetroChina Xinjiang Oilfield Company, Karamay; Xinjiang; 834000, China

**Corresponding author:** Abulimiti, Aibaibu (aibaibu@163.com)

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**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to solve the problem of coiled tubing fishing in the production string of gas wells with low pressures and low production rates, this paper puts forward a technical idea of fishing coiled tubing by using coiled tubing. Combined with the actual characteristics of gas wells with low pressure and low production, a series of special fishing tools were developed. And the technology was applied to Well T1 of Yangtake Condensate Gas Field in the western end of Luntai salient, Tabei uplift, the Tarim Basin. And the following research results were obtained. First, the necessary prerequisite for the smooth fishing operation is to unblock the operating channel by jet flow, verify the shape of the fish top by lead-in printing and determine the normal lifting load range by pull-up tests. Second, by virtue of the spin-in tool, the rotation fishing function of coiled tubing can be realized. By virtue of the catching-cutting tool, the dual purpose of catching fish and cutting fish in extreme cases can be achieved, so as to prevent the operation string from being broken and falling, which may cause a severe downhole accident. Based on the change of pump pressure, the capture detection tool can detect whether the fish top is introduced or not in time, effectively avoiding the situation that the fish is squeezed and broken due to blind loading in the introduction process. Third, Well T1, a gas well with low pressure and low production rate, has been shut down for a long time and its production channel is completely blocked. In addition, there are many variable diameter positions

in the operation channel. After this fishing technology is applied in Well T1 for fishing 13 times, the fish top is successfully introduced and fished with a success rate of 100%. In conclusion, this technology is applicable to coiled tubing fishing under the condition of limited space, and it provides an effective solution for the difficult fishing of coiled tubing in the production string of gas wells with low pressures and low production rates.

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**Number of references:** 16

**Main heading:** Coiled tubing

**Controlled terms:** Boreholes - Corrosion - Cutting tools - Fish - Fishing (oil wells) - Gas condensates - Gas industry - Gases - Natural gas well production - Natural gas wells - Oil field equipment

**Uncontrolled terms:** Condensate gas - Low pressures - Research and development - Tarim Basin - Velocity string

**Classification code:** 511.2 Oil Field Equipment - 512.2.1 Natural Gas Fields - 522 Gas Fuels - 603.2 Machine Tool Accessories - 619.1 Pipe, Piping and Pipelines

**Numerical data indexing:** Percentage 1.00e+02%

**DOI:** 10.3787/j.issn.1000-0976.2020.01.010

**Database:** Compendex

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4.

**Accession number:** 20202508845109

**Title:** Pore structures and fractal characteristics of liquid nitrogen adsorption pores in lignite in the Hailar Basin

**Title translation:** 海拉尔盆地褐煤液氮吸附孔的孔隙结构及分形特征

**Authors:** Shao, Longyi ; Li, Jiayu ; Wang, Shuai ; Hou, Haihai ; Li, Jian'an ; Zhu, Mingyu

**Author affiliation:** College of Geoscience and Surveying Engineering, China University of Mining and Technology, Beijing; 100083, China  
College of Mines, Liaoning Technical University, Huludao; Liaoning; 125105, China

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**Publication year:** 2020

**Pages:** 15-25

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**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The fractal dimension calculation method can be used to accurately and quantitatively describe pore structures in coal. In order to characterize the pore structures of adsorption pores in lignite in the Hailar Basin, this paper analyzed the pore structures of adsorption pores in the coal reservoirs of the study area by means of low temperature nitrogen adsorption experiments and scanning electron microscope (SEM). In addition, the fractal dimensions of adsorption pores in the coal samples were calculated using FHH (Frenkel-Halsey-Hill) model, and the relationships of maximum vitrinite reflectance ( $R_o, \max$ ) and fractal dimension vs. coal quality, pore specific surface area and total pore volume were discussed. And the following research results were obtained. First, the adsorption-desorption curves of coal samples in the study area can be divided into 3 types, i.e., type A, B and C. Second, type A pores are morphologically open parallel plate pores and cylinder pores with a large specific surface area and total pore volume and a small average pore diameter. Third, type B pores are morphologically open parallel plate pores and wedge shaped pores with a small specific surface area and total pore volume and a large average pore diameter. Fourth, type C pores are morphologically parallel plate pores and wedge shaped pores with one end closed, which have a small specific surface area and a large total pore volume and average pore diameter. Fifth, the fractal dimension of coal pore surface ( $D_1$ ) has no relationship with moisture content, a positive correlation with ash yield rate, a "U" shaped relationship with fixed carbon content and an inverted "U" shaped relationship with  $R_o, \max$ . Sixth, the fractal dimension of pore structure ( $D_2$ ) has a negative correlation with moisture content, a positive correlation with ash yield rate, a "U" shaped relationship with fixed carbon content and no relationship with  $R_o, \max$ .

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**Number of references:** 40

**Main heading:** Fractal dimension

**Controlled terms:** Carbon - Coal tar - Coking properties - Gas adsorption - Lignite - Liquefied gases - Moisture - Moisture determination - Plates (structural components) - Pore structure

- Scanning electron microscopy - Specific surface area - Temperature

**Uncontrolled terms:** Adsorption desorption - Fractal characteristics - Large specific surface areas - Low-temperature nitrogen - Negative correlation - Nitrogen adsorption - Positive correlations - Vitrinite reflectance

**Classification code:** 408.2 Structural Members and Shapes - 411.2 Coal Tar - 524 Solid Fuels - 641.1 Thermodynamics - 802.3 Chemical Operations - 804 Chemical Products Generally - 921 Mathematics - 931.2 Physical Properties of Gases, Liquids and Solids - 944.2 Moisture Measurements

**DOI:** 10.3787/j.issn.1000-0976.2020.05.002

**Database:** Compendex

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5.

**Accession number:** 20203509114435

**Title:** Optimization of shale-gas horizontal well spacing based on geology-engineering-economy integration: A case study of Well block Ning 209 in the National Shale Gas Development Demonstration Area

**Title of translation:** 地质-工程-经济一体化页岩气水平井井距优化-以国家级页岩气开发示范区宁209井区为例

**Authors:** Yong, Rui ; Chang, Cheng ; Zhang, Deliang ; Wu, Jianfa ; Huang, Haoyong ; Jing, Daijiao ; Zheng, Jian

**Author affiliation:** PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China

Shale Gas Research Institute, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China

Natural Gas Economics Research Institute, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China

Sichuan Changning Natural Gas Development Co., Ltd., Chengdu; Sichuan; 610056, China

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**ISSN:** 10000976**CODEN:** TIGOE3**Document type:** Journal article (JA)**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to maximize the resource utilization rate, it is common to adopt one-time overall deployment of well pattern to develop shale gas, and the design of horizontal well spacing is the key to the deployment of shale gas well pattern. To determine the optimal well spacing, it is not only necessary to understand both geological characteristics and drilling fracturing technology, but also take into consideration the influences of economic factors, such as gas price and cost. At present, there is no reliable method for designing the well spacing of shale-gas horizontal wells at home and abroad. In this paper, a method for analyzing the well spacing of shale-gas horizontal wells based on the integration of geology, engineering and economy was established for the first time. Then, by means of geological modeling, numerical simulation and cash flow analysis, the well spacing of shale-gas development wells in Well block Ning 209 in Changning-Weiyuan National Shale Gas Demonstration Area in the Sichuan Basin was comprehensively evaluated by using estimated ultimate reserve (EUR), recovery factor and internal rate of return (IRR). And the following research results were obtained. First, under the current geological, engineering and economic conditions of Well Block Ning 209, the IRR of shale gas platform development can be kept greater than 8% if the well spacing is larger than 240 m. Second, when the well spacing is controlled between 330 m and 380 m, single well EUR, recovery rate of the platform and economic benefit can be considered simultaneously. In conclusion, the research results support the formulation of the shale gas development technology policy of Well Block Ning 209 and lay a foundation for the realization of its scale efficient development of shale gas.

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**Number of references:** 19**Main heading:** Well spacing**Controlled terms:** Earnings - Economic and social effects - Gases - Geology - Horizontal wells - Proven reserves - Shale gas**Uncontrolled terms:** Cash flow analysis - Drilling fracturing - Economic condition - Engineering economy - Geological characteristics - Geological modeling - Internal rate of return - Resource utilizations**Classification code:** 481.1 Geology - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 911.2 Industrial Economics - 971 Social Sciences**Numerical data** Percentage 8.00e+00%, Size 2.40e+02m, Size 3.30e+02m to

**indexing:** 3.80e+02m

**DOI:** 10.3787/j.issn.1000-0976.2020.07.005

**Database:** Compendex

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6.

**Accession number:** 20200908220908

**Title:** Innovation and practice of the key technologies for the efficient development of the Supergiant Anyue Gas Field

**Title of translation:** 安岳特大型气田高效开发关键技术创新与实践

**Authors:** Xie, Jun

**Author affiliation:** PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China

**Corresponding author:** Xie, Jun (xiejun01@petrochina.com.cn)

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**Pages:** 1-10

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In recent years, the Sichuan Basin has been the most potential hydrocarbon-bearing basin in China thanks to the great exploration and development breakthroughs of deep large integral carbonate gas reservoirs and shale gas in this basin. The Anyue Gas Field located in central Sichuan Basin is not only the largest carbonate gas reservoir, but the most important supergiant gas field discovered in China in recent years. However, it faces a series of major difficulties, e.g. low reservoir porosity, low permeability, low gas well productivity, thin and vertically and laterally disperse gas layer, strong heterogeneity, quite low structural amplitude and complicated gas-water relationship, which bring great challenges to the rapid conversion of natural

gas reserves to production. In this regard, technical researches have been carried out continuously. As a result, many key technologies have been innovatively integrated and great breakthroughs have been realized in many aspects. First, fine development technologies for supergiant, ancient and complex carbonate gas reservoirs are developed innovatively, "transparent gas reservoir" is constructed and the technologies for cultivating high-yield wells are established. By virtue of these technologies, all development wells in the gas reservoir of Lower Cambrian Longwangmiao Formation reach the target of high yield and the single-well gas production rate of the gas reservoir of Lower Sinian Dengying Formation is increased significantly, which provides support for the long-term high production and stable production of Anyue Gas Field. Second, good and fast construction technologies for large-scale gas fields are innovatively integrated. Based on this, the safety of gas wells is under control in the whole life cycle, quality engineering is built up efficiently within 3 years, green mining areas are forged and large-scale safe and clean gas fields are built up efficiently. Third, intelligent control technologies for the development of supergiant gas fields are innovatively integrated. By means of these technologies, internet of everything, depth perception and automatic production are realized. The intelligent technologies of new generation are fused, including AR, VR, robot and unmanned aerial vehicle (UAV). A new intelligent management mode for gas field development is set up, and an intelligent gas field is built up. Fourth, optimization technologies for the overall development of supergiant gas fields are innovatively developed, so as to improve the development effects of strong-heterogeneity gas reservoirs and ensure the long-term stable production of supergiant water-bearing gas reservoirs. The research results can be used as reference for the efficient development of similar domestic and foreign gas fields.

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**Number of references:** 27

**Main heading:** Reservoir management

**Controlled terms:** Antennas - Bearings (machine parts) - Carbonation - Depth perception - Gas industry - Gas permeability - Gases - Intelligent robots - Life cycle - Low permeability reservoirs - Natural gas - Natural gas well production - Natural gas wells - Natural gasoline plants - Oil bearing formations - Petroleum reservoir engineering - Proven reserves - Quality control - Unmanned aerial vehicles (UAV)

**Uncontrolled terms:** Central Sichuan Basin - Efficient development - Gas fields - Gas reservoir - Intelligent management - Strong heterogeneities

**Classification code:** 512 Petroleum and Related Deposits - 513.2 Petroleum Refineries - 522 Gas Fuels - 601.2 Machine Components - 652.1 Aircraft,

General - 731.6 Robot Applications - 802.2 Chemical Reactions -  
913.3 Quality Assurance and Control - 931.2 Physical Properties of  
Gases, Liquids and Solids

**Numerical data indexing:** Age 3.00e+00yr

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7.

**Accession number:** 20202908937815

**Title:** Progress and prospect of key experimental technologies for shale gas geological evaluation

**Title of translation:** 页岩气地质评价关键实验技术的进展与展望

**Authors:** Wang, Hongyan ; Zhou, Shangwen ; Liu, Dexun ; Jiao, Pengfei ; Liu, Honglin

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration & Development, Beijing; 100083, China  
National Energy Shale Gas R & D <Experiment> Center, Langfang; Hebei; 065007, China  
CNPC Key Laboratory of Unconventional Oil & Gas, Langfang; Hebei; 065007, China

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**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The development of shale gas geological evaluation experimental technology is of great significance for shale gas "sweet spot" evaluation, geological selection, and reserves calculation. In recent years, with the development of shale gas exploration and

development in China, such technology has made great progress especially in the three aspects of shale micro-pore structure, gas bearing property and petrophysical property. Through the combination of advanced technology introduction and independent development of equipments, the analysis and test technology and standards applicable to marine shale in China have already been established, which plays an important role in promoting the exploration and development of shale gas in China. In this regard, we systematically summarized the progress of the above three key technologies at home and abroad, and looks forward to development trends in the future. As for shale micro-pore structure tests, a variety of qualitative observation and quantitative characterization test methods have been formed, realizing the transformation from static to dynamic characterization, while further research needs to be done in the aspects of in-situ characterization of shale pore structure and direct observation of fluid occurrence characteristics in pores. As for shale gas bearing tests, a series of on-site and indoor gas bearing characterization technologies have been established to realize the quantitative evaluation of adsorbed and free gas occurrence characteristics in shale, while further research is needed in lost gas calculation for deep shale, shale gas adsorption mechanism and models. As for shale petrophysical property tests, the porosity and permeability test technology combined with various methods has been established to realize the quantitative evaluation of shale porosity effectiveness, but it is still necessary to carry out comparative research and unify the standards in terms of porosity test conditions and methods so as to meet the requirements of both research and production.

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**Number of references:** 135

**Main heading:** Oil bearing formations

**Controlled terms:** Gas adsorption - Gas bearings - Gases - Geological surveys - Petrophysics - Pore structure - Porosity - Proven reserves - Shale gas - Testing

**Uncontrolled terms:** Dynamic characterization - Exploration and development - In-situ characterization - Micro-pore structures - Petrophysical properties - Qualitative observations - Quantitative characterization - Quantitative evaluation

**Classification code:** 481.1 Geology - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 601.2 Machine Components - 802.3 Chemical Operations - 931.2 Physical Properties of Gases, Liquids and Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.06.001

**Database:** Compendex

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8.

**Accession number:** 20202908937726

**Title:** Key geological factors for shale gas accumulation in the Wufeng-Longmaxi Fms in the central Yangtze area

**Title of translation:** 中扬子地区五峰组-龙马溪组页岩气成藏关键地质因素

**Authors:** Chen, Kongquan ; Li, Junjun ; Tang, Xiehua ; Shen, Junjun ; Wang, Pengwan ; Peng, Jun ; Meng, Jianghui

**Author affiliation:** Hubei Cooperative Innovation Center of Unconventional Oil and Gas of Yangtze University, Wuhan; Hubei; 430100, China  
PetroChina Zhejiang Oilfield Company, Hangzhou; Zhejiang; 310013, China  
Exploration & Development Institute, PetroChina Zhejiang Oilfield Company, Hangzhou; Zhejiang; 310013, China  
PetroChina Hangzhou Research Institute of Geology, Hangzhou; Zhejiang; 310023, China

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**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The Upper Ordovician Wufeng Formation and the Lower Silurian Longmaxi Formation in the central Yangtze area of southern China has a good prospect of shale gas exploration. So far, however, its complicated geological conditions and shale gas exploration and development potentials have not been understood completely, which affects its exploration achievements. In order to determine the main factors controlling shale gas enrichment in the Wufeng-Longmaxi Fms in this area, this paper studied the key shale gas enrichment conditions in the black shale there (e.g. sedimentary environments, reservoir development characteristics and preservation conditions) based on single-well comprehensive reservoir evaluation, combined with

drilling, logging, core, outcrop and test data. In addition, it was compared with the main shale gas blocks in the Sichuan Basin, such as Jiaoshiba and Changning. And the following research results are obtained. First, the organic-rich shale section in this area was formed during the sedimentation from Wufeng Formation to the third submember of the first Member of Longmaxi Formation. It is the deposit of deepwater continental facies, and its thickness is in a range of 15-39 m, presenting a trend of increasing from south to north. Second, the reservoir rocks in the high-quality shale sections are dominated by siliceous shale, and the reservoir porosity is in a range of 1.60-7.44%. The reservoir spaces are dominated by organic pores with good connectivity and high total organic carbon (TOC) content. The organic matter is of a sapropel-sapropel prone hybrid type, with a high thermal evolution degree, better gas bearing property and good fracability. Third, the Danyang synclinorium is characterized by better strata preservation, rock occurrence flat, less developed faults and thick and stable roofs and floors, so its shale gas preservation conditions are better. Fourth, different from the Changning and Jiaoshiba Blocks, the central Yangtze area is characterized by great burial depth, large bidirectional stress difference, and low formation pressure coefficient. In conclusion, the Wufeng-Longmaxi Fms is better in shale gas enrichment conditions and has a potential of further exploration. However, its commercial shale gas development and scale production increase in the future face challenges due to its large stress difference, great burial depth, and lower pressure coefficient.

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**Number of references:** 34

**Main heading:** Petroleum prospecting

**Controlled terms:** Deposition - Gas industry - Gases - Geological surveys - Geology - Offshore gas fields - Organic carbon - Petroleum reservoir evaluation - Shale gas

**Uncontrolled terms:** Central Yangtze areas - Complicated geological conditions - Danyang synclinorium - Low formation pressure - Preservation condition - Reservoir development - Sedimentary environment - Total Organic Carbon

**Classification code:** 481.1 Geology - 512.1.2 Petroleum Deposits : Development Operations - 512.2.1 Natural Gas Fields - 522 Gas Fuels - 802.3 Chemical Operations - 804.1 Organic Compounds

**Numerical data indexing:** Percentage 1.60e+00% to 7.44e+00%, Size 1.50e+01m to 3.90e+01m

**DOI:** 10.3787/j.issn.1000-0976.2020.06.002

**Database:** Compendex

9.

**Accession number:** 20202508844900

**Title:** **Experimental evaluation on the anti-erosion performance of throttle valves for drilling**

**Title of translation:** 钻井用节流阀抗冲蚀性能的实验评价

**Authors:** Cao, Yang ; Fang, Xiaoqing ; Zhang, Junlan ; Tang, Dixiao

**Author affiliation:** Oilfield Engineering Service Company, Sinopec Southwest Petroleum Engineering Co. Ltd., Mianyang; Sichuan; 621000, China

**Corresponding author:** Fang, Xiaoqing (fangxq008@163.com)

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**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** When a blowout accident happens, throttle valve is the key device to control the flow velocity of fluid in a well, so its erosion resistance shall be stronger. At present, however, the evaluation on the anti-erosion performance of throttle valves mostly focuses on finite element analysis or fluid field simulation calculation, with neither measured data nor qualitative and quantitative evaluation, which brings great difficulties to the selection and application of throttle valves. In this paper, an experimental idea was adopted of adjusting the experimental pressure and fluid velocity based on the remote control of valve opening and keeping the nitrogen injection pressure slightly higher than the experimental pressure to ensure that the gas is effectively mixed to form three-phase fluid. Closed-loop simulation was performed on the erosion of blowout on three kinds of throttle valves (orifice-type throttle valves, cylindrical throttle valves and wedge-shaped throttle valves) under different flow velocities, different fluid components

and different pressures. And the following experimental results were obtained. First, from the viewpoint of erosion resistance, three kinds of throttle valves are ranked as a cylindrical throttle valve > a wedge-shaped throttle valve > an orifice-type throttle valve. Second, within the experimental pressure range, a wedge-shaped throttle valve has slight erosion marks on the valve core and unilateral erosion on the downstream nipple, indicating that its erosion resistance is weak. Third, when the opening of an orifice-type throttle valve is 1/8, the experimental pump pressure drops back to 4 MPa for many times, and the rear end of the valve core is seriously eroded. Finally, according to the experimental results, the improvement ideas of changing the core's shape of a wedge-shaped throttle valve, optimizing the material and adding seals on the side of an orifice-type throttle valve were put forward. In conclusion, the three-phase fluid erosion resistance evaluation method can be used to evaluate throttle valves of similar structure.

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**Number of references:** 17

**Main heading:** Erosion

**Controlled terms:** Blowouts - Flow velocity - Orifices - Remote control

**Uncontrolled terms:** Closed-loop simulations - Different pressures - Erosion resistance - Experimental evaluation - Fluid components - Fluid velocities - Nitrogen injection - Quantitative evaluation

**Classification code:** 631 Fluid Flow - 731.1 Control Systems - 914.1 Accidents and Accident Prevention

**Numerical data indexing:** Pressure 4.00e+06Pa

**DOI:** 10.3787/j.issn.1000-0976.2020.05.011

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

10.

**Accession number:** 20201208317064

**Title:** **Drilling and completion technologies for deep carbonate rocks in the Sichuan Basin: Practices and prospects**

**Title of translation:** 四川盆地深层碳酸盐岩钻完井技术实践与展望

**Authors:** Wu, Xianzhu ; Wan, Fulei ; Chen, Zuo ; Han, Liexiang ; Li, Zhilin

**Author affiliation:** National Energy R & D Center of High-Sulfur Gas Reservoir Exploitation, Chengdu; Sichuan; 610041, China  
CNPC Chuanqing Drilling Engineering Co., Ltd., Chengdu; Sichuan; 610051, China

**Corresponding author:** Wan, Fulei (wanfl@cnpc.com.cn)

**Source title:** Natural Gas Industry

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**Publication year:** 2020

**Pages:** 97-105

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The exploration and development of oil and gas resources in the Sichuan Basin is shifting to the deeper strata. The deep and ultra-deep wells in deep carbonate gas reservoirs are faced with many difficulties, such as multiple pressure systems, poor drillability, ultra-high pressure, ultra-high temperature and high sulfur content, which bring great challenges to drilling and completion engineering. In order to ensure the smooth exploration and development of deep carbonate oil and gas resources in the Sichuan Basin, the overall concept of combining field practice and technological research is followed. During the 13th Five-Year Plan, a batch of ultra-deep wells (well depth about 8 000 m) have been drilled fast and safely (such as Well SYX133 in the Shuangyushi structure), and great progresses have been achieved in the experimental research of the support technologies in drilling and completion of deep and ultra-deep wells. And the achievements are as follows. First, the optimization of non-standard well structure, combined with the application of precisely managed pressure drilling technology and under-pressure plugging technology, lays a foundation for the optimized fast drilling and the safe reaching of geological targets. Second, a high-efficiency customized PDC drill bit is comprehensively optimized, popularized and applied, which effectively improves the average rate of penetration (ROP) in difficult-to-drill formations. Third, the development and application of drilling fluids (e.g. being resistant to high temperature of 200°C and anti-composite brine) and active under-pressure plugging technology effectively reduces downhole complexities while drilling the complex formations, such as high temperature and high pressure brine and circulation loss. Fourth, when precisely managed pressure drilling and precisely managed pressure cementing methods are applied in

the strata with a narrow density window, multiple pressure systems and pressure sensitivity, the average drilling and completion fluid loss is reduced by more than 90%, and the complexity treatment time is cut down by more than 85%, and the cementing quality pass rate is increased by more than 20%. Fifth, the integrated application of ROP improvement technologies and tools (e.g. gas drilling) results in a great reduction of drilling cycle and cost. It is concluded that the experimental research achievements provide basic support for the fast development of natural gas resources in the Anyue Gas Field, Sichuan Basin, and the great discovery of the Permian and Devonian natural gas resources in the northwestern Sichuan Basin. What's more, in order to adapt to the development of the deep natural gas (over 9 000 m) in the Sichuan Basin during the 14th Five-Year Plan, it is necessary to speed up researches on drilling and completion technologies in nine aspects, e.g. high-temperature downhole tools and working fluid.

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**Number of references:** 34

**Main heading:** Natural gas well completion

**Controlled terms:** Bits - Carbonation - Cementing (shafts) - Drilling fluids - Drills - Energy resources - Gas industry - Gases - High pressure engineering - High temperature engineering - Infill drilling - Natural gas - Natural gas fields - Oil field development - Petroleum prospecting - Reservoir management - Structural optimization

**Uncontrolled terms:** Drilling and completion - Drilling and completion fluids - Gas reservoir - Managed Pressure Drilling - Sichuan Basin - Ultra-deep wells - Well structure

**Classification code:** 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 522 Gas Fuels - 525.1 Energy Resources and Renewable Energy Issues - 603.2 Machine Tool Accessories - 802.2 Chemical Reactions - 921.5 Optimization Techniques

**Numerical data indexing:** Percentage 2.00e+01%, Percentage 8.50e+01%, Percentage 9.00e+01%, Size 8.00e+03m, Size 9.00e+03m

**DOI:** 10.3787/j.issn.1000-0976.2020.02.011

**Database:** Compendex

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11.

**Accession number:** 20202908937735

**Title:** A new coal reservoir permeability model considering the influence of pulverized coal blockage and its application

**Title of** 考虑煤粉堵塞影响的煤储层渗透率模型及其应用

**translation:**

**Authors:** Shi, Juntao ; Wu, Jiayi ; Fang, Yexin ; Lu, Jianguo ; Hou, Chenhong ; Li, Xiangfang ; Zhang, Sui'an ; Xiong, Xianyue

**Author affiliation:** Coalbed Methane Research Center, China University of Petroleum, Beijing; 102249, China  
State Key Laboratory of Petroleum Resources and Prospecting, China University of Petroleum, Beijing; 102249, China  
CNOOC Gas & Power Group, Beijing; 100028, China  
PetroChina Coalbed Methane Co., Ltd., Beijing; 100028, China

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**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to accurately predict the production performance of coalbed methane (CBM) wells and to formulate a reasonable production system, this paper established a coal reservoir permeability model considering the influence of pulverized coal blockage. Then, on the basis of this model, the flow velocity sensitivity (FVS) experimental data of 15 groups of coal samples taken from the Baode Block, Qinshui Basin, Liulin Block, Hancheng Block and the Huanglong Coalfield were fitted to determine the permeability models for different coal samples. On this basis, this newly established permeability model was incorporated into a previously developed CBM well performance analysis software, and production history matching was carried out on two CBM wells. Finally, the effects of the parameters of pulverized coal blockage on the permeability of coal reservoirs and the production performance of CBM wells were studied by taking the fitting parameters of CBM Well W1 as the reference. And the following research results are obtained. First, this new model considering the influence of pulverized coal blockage can quantitatively describe the variation of coal reservoir permeability with fluid velocity. In addition, this model can be incorporated into a CBM numerical simulation software or a CBM well performance analysis software to apply it in a wide range. Second,

the coal reservoir permeability is less affected by pulverized coal blockage in the Baode Block, but this effect shall not be ignored in the Qinshui Basin and the Huanglong Coalfield. Third, the greater the theoretical maximum permeability damage degree ( $D_{max}$ ) and the permeability damage degree index ( $n$ ) are, the lower the relative flow velocity ( $v_{0.5}$ ) corresponding to the critical flow velocity of pulverized coal blockage is and the more obvious the effect of pulverized coal blockage on coal reservoir permeability. Fourth, in order to reduce the adverse effect of pulverized coal blockage on coal reservoir permeability, it is suggested to reduce the production pressure difference appropriately in the process of production, especially in the initial stage of gas production, so as to avoid severe damage to coal reservoir permeability.

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**Number of references:** 47

**Main heading:** Pulverized fuel

**Controlled terms:** Coal - Coal deposits - Coal industry - Computer software - Flow velocity - Gas industry - Mechanical permeability - Methane - Natural gas wells - Petroleum reservoir engineering - Velocity

**Uncontrolled terms:** Critical flow velocity - Fitting parameters - Numerical simulation software - Permeability damage - Permeability model - Production performance - Production pressure differences - Velocity sensitivity

**Classification code:** 503 Mines and Mining, Coal - 512.1.2 Petroleum Deposits : Development Operations - 512.2.1 Natural Gas Fields - 522 Gas Fuels - 524 Solid Fuels - 631 Fluid Flow - 723 Computer Software, Data Handling and Applications - 804.1 Organic Compounds

**DOI:** 10.3787/j.issn.1000-0976.2020.06.008

**Database:** Compendex

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12.

**Accession number:** 20201708556760

**Title:** In-situ stress profile prediction based on the rheological model: A case study of Well AY-1 in the Qianbei area of Guizhou Province

**Title of translation:** 基于流变模型的地应力剖面预测--以贵州黔北地区安页1井为例

**Authors:** Sun, Dongsheng ; Pang, Fei ; Li, Awei ; Wang, Yufang ; Yang, Yuehui ; Chen, Qunce

**Author affiliation:** Institute of Geomechanics, Chinese Academy of Geological Sciences, Beijing; 100081, China

Key Laboratory of Active Tectonics and Crustal Stability  
Assessment, Beijing; 100081, China

China Geological Survey, Beijing; 100029, China

Oil & Gas Survey, China Geological Survey, Beijing; 100029,  
China

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source title:** Natur. Gas Ind.

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**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 58-64

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In-situ stress is a key parameter in the sweet-spot assessment, horizontal well arrangement and fracturing design in the exploration and development of unconventional oil and gas reservoirs. At present, the elastic model based on in-situ stress evaluation technology which is used for conventional reservoirs is applied to shale reservoirs at home and abroad while the effects of rheological behaviors on the distribution laws of in-situ stress in shale reservoirs are not taken into consideration, which brings a larger error to the evaluation result of in-situ stress of shale reservoirs. In this paper, a new in-situ stress evaluation method base on the rheological model was put forward to increase the evaluation and calculation accuracy of in-situ stress parameters. Then, the variation laws of rock rheological parameters with the depth were determined by using the rock mechanical parameters obtained from cross-dipole acoustic logging data, referring to the related experimental results. And combined with the burial history of the basin and the strain rate of the crust, the in-situ stress profile of Well AY-1 in the Qianbei area of Guizhou Province was established. Finally, the in-situ stress evaluated by the new method was compared with the one measured in the mini frac and the one determined by the stress polygon method. And it is indicated that the in-situ stress profile of Well AY-1 predicted by the new method is consistent with the test result and its in-situ evaluation result presents a good corresponding relationship with the result of Gamma logging. As the content of clay mineral or organic matter increases, the horizontal principal stress difference decreases, indicating that the in-situ stress evaluation result by

the new method is in better accordance with the distribution law of true in-situ stress.

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**Number of references:** 20

**Main heading:** Petroleum reservoir evaluation

**Controlled terms:** Acoustic logging - Horizontal wells - Oil field development - Oil well logging - Petroleum prospecting - Petroleum reservoirs - Shale - Strain rate - Stress analysis

**Uncontrolled terms:** Calculation accuracy - Exploration and development - In-situ stress profiles - Rheological behaviors - Rheological modeling - Rheological parameter - Rock mechanical parameters - Unconventional oil and gas

**Classification code:** 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 751.2 Acoustic Properties of Materials - 951 Materials Science

**DOI:** 10.3787/j.issn.1000-0976.2020.03.007

**Database:** Compendex

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13.

**Accession number:** 20202308801537

**Title:** Thermal reservoir characteristics and favorable targets of Ordovician carbonate rocks in the Taiyuan area

**Title of translation:** 太原地区奥陶系碳酸盐岩热储特征及勘探有利区

**Authors:** Dai, Minggang ; Lei, Haifei ; Ling, Anhang ; Mao, Xiang ; Wang, Simin ; Xiang, Caifu

**Author affiliation:** Sinopec Star Petroleum Co., Ltd., Beijing; 100083, China  
China National Center for Geothermal Energy Development Research and Applied Technology Promotion, Beijing; 100083, China  
Sinopec Green Energy Geothermal Development Co., Ltd., Xiong'an; Hebei; 071800, China  
China University of Petroleum, Beijing, Beijing; 102249, China

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**Issue date:** April 25, 2020

**Publication year:** 2020

**Pages:** 143-155

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The geothermal resources of Ordovician carbonate rocks are abundant in the Taiyuan area, Shanxi province. In order to achieve a better understanding of the characteristics, genesis and controlling factors there and guide the exploration of this type of geothermal fields, we studied the development characteristics of Ordovician thermal reservoir rocks, reservoir space types, and diagenesis types in this study area based on the data of core and outcrop observation, thin section and scanning electron microscopy, and revealed the main controlling factors of thermal reservoir characteristics and the most favorable targets. The following results were achieved. (1) The Ordovician thermal reservoirs in the Taiyuan area mainly consist of limestones and dolomites, with karst caves, fractures, and pores as the main reservoir space. (2) The reservoirs are subjected to both destructive and constructive diagenesis, and karstification and dolomitization have dominant influence on the formation of secondary pores. (3) Karstification results in mainly supergene karst and buried karst. The contribution of supergene karstification to reservoirs is dominant, and burial karstification plays a significant role in the later dissolution and transformation of reservoirs, which increases their porosity. (4) Ordovician carbonate reservoirs are generally located in the karst slope zones with a good storage performance on the thermal reservoir plane. The lithology of thermal reservoir aquifers presents usually limestones and dolomites with impure composition and high crystallinity. (5) The development and distribution of thermal reservoir karst pores mainly depend on lithology (including rock composition, texture, thickness, etc. ), structure (fracture and unconformity), sedimentary facies, groundwater dynamic conditions, and other controlling factors, especially, tectonic faults control the direction, affecting karst development scale and karst fissure hydrodynamic conditions. It is concluded that the most favorable targets for Ordovician carbonate thermal reservoir karst development in the Taiyuan area are the northwestern and eastern parts of the Jinyuan sag and the central and western parts of the Xiwenzhuang uplift.

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**Number of references:** 29

**Main heading:** Landforms

**Controlled terms:** Aquifers - Carbonates - Carbonation - Crystallinity - Digital storage - Geothermal fields - Groundwater resources - Hydrogeology - Lime - Limestone - Lithology - Petroleum reservoirs - Scanning electron microscopy - Sedimentology - Textures

**Uncontrolled terms:** Carbonate reservoir - Controlling factors - Development characteristics - Geothermal resources - Groundwater dynamics - Hydrodynamic conditions - Main controlling factors - Storage performance

**Classification code:** 444.2 Groundwater - 481.1 Geology - 481.3.1 Geothermal Phenomena - 512.1.1 Oil Fields - 722.1 Data Storage, Equipment and Techniques - 802.2 Chemical Reactions - 804.2 Inorganic Compounds

**DOI:** 10.3787/j.issn.1000-0976.2020.04.018

**Database:** Compendex

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14.

**Accession number:** 20202308799538

**Title:** Development and application of GW-CP194-80A pressure-maintaining coring tool

**Title of translation:** GW-CP194-80A型保压取心工具的研制

**Authors:** Yang, Liwen ; Su, Yang ; Luo, Jun ; Sun, Shaoliang

**Author affiliation:** GWDC Engineering Technology Research Institute, Panjin; Liaoning; 124010, China

**Corresponding author:** Su, Yang (122474292@qq.com)

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**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Publication year:** 2020

**Pages:** 91-96

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**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Pressure-maintaining coring technology can reduce the loss of hydrocarbon compositions in cores to the uttermost while keeping the cores in the state of original formation pressure, so as to obtain important formation parameters under the conditions of bottom hole, e. g. reservoir fluid saturation. At present, it is the most advanced coring technology with the highest technical difficulty. Compared with foreign similar technical products, however, there is an obvious gap between the domestic existing pressure-maintaining coring tools in two main technical indexes, i. e. core diameter and pressure maintaining capacity. And especially in the aspect of pressure maintaining capacity, domestic products can hardly meet the needs of pressure-maintaining coring operations in deep sea drilling, onshore deep wells and horizontal wells, which limits its application scope and popularity rate. In this paper, GW-CP194-80A tripping-out pressure-maintaining coring tool (hereinafter, "new tool" for short) was designed and developed on the basis of GWY194-70BB pressure-maintaining coring tool. And the following field application results were obtained. First, the diameter of the core taken by the new tool is increased from 70 mm to 80 mm, and the rated pressure maintaining capacity is increased from 20 MPa to 60 MPa by adopting the large-diameter ball valve sealing device of controllable rotation and the high-strength pressure-maintaining inner cylinder. Second, internal-lift differential assembly and upper-lower synchronous sealing mechanism in the new tool effectively solve the closing problem of ball valves and increase the success rate of pressure maintaining in the coring process of high inclination wells and horizontal wells. Third, during the field application of the new tool in 5 wells by 27 barrel times, the average core recovery rate is 87.5% and the success rate of pressure maintaining is 92.6%. In conclusion, the new tool can reach the design target of core diameter and pressure maintaining capacity, meet the needs of pressure maintaining coring in deep sea, deep seated and unconventional oil and gas reservoirs, and provide technical support for the reservoir evaluation and stimulation of conventional and unconventional oil and gas reservoirs.

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**Number of references:** 22

**Main heading:** Petroleum reservoir evaluation

**Controlled terms:** Deepwater drilling - Horizontal wells - Offshore gas fields - Petroleum reservoirs - Sealing (closing)

**Uncontrolled terms:** Development and applications - Formation parameter - Formation pressure - High inclination well - Hydrocarbon compositions - Sealing mechanisms - Technical difficulties - Unconventional oil and gas

**Classification** 511.1 Oil Field Production Operations - 512 Petroleum and

**code:** Related Deposits

**Numerical data indexing:** Percentage 8.75e+01%, Percentage 9.26e+01%, Pressure 2.00e+07Pa to 6.00e+07Pa, Size 7.00e-02m to 8.00e-02m

**DOI:** 10.3787/j.issn.1000-0976.2020.04.011

**Database:** Compendex

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15.

**Accession number:** 20202308799552

**Title:** **Characteristics and geological significance of fluid inclusions in the Lower Permian Shanxi Formation in the Yan'an Gas Field**

**Title of translation:** 延安气田下二叠统山西组流体包裹体特征及其地质意义

**Authors:** Zhou, Jinsong ; Qiao, Xiangyang ; Wang, Ruogu ; Yin, Xiao ; Liu, Peng

**Author affiliation:** Research Institute of Shaanxi Yanchang Petroleum <Group> Co., Ltd., Xi'an; Shaanxi; 710075, China

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**Pages:** 20-29

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**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In recent years, great breakthroughs have been made in natural gas exploration in Upper Paleozoic in the southeastern Ordos Basin. In order to understand the gas accumulation process of Upper Paleozoic in this area, this paper analyzed the characteristics of reservoir fluid inclusions (e. g. color, form, composition and homogenization temperature) by taking the principal pay zone of Upper Paleozoic gas reservoir in the Yan'an Gas Field of southeastern Ordos Basin as an example. Then, combined with the burial history and thermal history simulation, the formation period of fluid inclusions was determined, and the geological age of the hydrocarbon charging was defined, and the

coupling relationship between hydrocarbon charging and diagenetic evolution was analyzed. And the research conclusions were as follows. First, the reservoir fluid inclusions of Shanxi Formation in the Yan'an Gas Field mainly exist in authigenic quartzs, carbonate cements and concrescence fractures of quartz grain, and they are classified into three types, i. e., CO<sub>2</sub> inclusion, hydrocarbon inclusion and brine inclusions. Second, the formation of hydrocarbon inclusions is mainly divided into two phases. In the first phase, they are mainly developed at quartz overgrowth edges and concrescence fractures of quartz grain, where the homogenization temperature is between 90°C and 110°C and the gas hydrocarbon components are mainly rich in CO<sub>2</sub> and CH<sub>4</sub>. And in the second phase, they are mainly developed at quartz overgrowth edges, carbonate cements and concrescence fractures of quartz grain, where the homogenization temperature is between 130°C and 160°C, and the gas hydrocarbon component is rich in CH<sub>4</sub>. Third, there are two hydrocarbon charging phases in the Shanxi Formation. The first phase occurred in the Late Triassic to the Early and Middle Jurassic, during which the organic matter began to generate, expel and charge hydrocarbon, secondary pores were formed by the dissolution of feldspar and lithic, and chemical pressure dissolution initially occurred and generated a small number of quartz overgrowth edges. In the Middle and Late Jurassic, source rocks entered the mature stage and began to generate and expel a great amount of hydrocarbon; the second phase of hydrocarbon charging began; the chemical pressure dissolution was strengthened; and the quartz cement was developed in a great quantity. In the Early Cretaceous, source rocks reached the high and over-mature stage and generated a large amount of gas, quartz cements continued to grow, and ferroan dolomite began to precipitate. Since the end of the Early Cretaceous, hydrocarbon generation from source rocks gradually ceased.

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**Number of references:** 23

**Main heading:** Petroleum prospecting

**Controlled terms:** Carbon dioxide - Cements - Dissolution - Feldspar - Fracture - Gases - Geology - Hydrocarbons - Metamorphic rocks - Mineralogy - Petroleum reservoirs - Quartz

**Uncontrolled terms:** Coupling relationships - Diagenetic evolution - Geological significance - Homogenization temperatures - Hydrocarbon generation - Natural gas exploration - Reservoir fluid inclusions - Thermal history simulation

**Classification code:** 412.1 Cement - 481.1 Geology - 482 Mineralogy - 482.2 Minerals - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 802.3 Chemical Operations - 804.1 Organic Compounds - 804.2 Inorganic Compounds - 951 Materials Science

**DOI:** 10.3787/j.issn.1000-0976.2020.04.003

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16.

**Accession number:** 20200908220943

**Title:** Correlation of shale core analysis results and its influencing factors

**Title of translation:** 页岩岩心样品分析数据对比及其影响因素分析

**Authors:** Wang, Shiqian

**Author affiliation:** Research Institute for Shale Gas, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China

**Corresponding author:** Wang, Shiqian (wsq-618@petrochina.com.cn)

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**Pages:** 160-174

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Over the last decade, a large number of gas-shale cores have been acquired during the exploitation of the Lower Paleozoic Wufeng-Longmaxi shale gas in the Southern Sichuan Basin, and in the joint appraisal of shale gas blocks in cooperation with several overseas international petroleum companies. Therefore, huge quantities of shale core data about shale mineralogy, geochemistry, petrophysics and gas content have been accumulated and measured in different labs at home and abroad. By correlating the core data from the same piece of sample or from the samples in the same intervals, it is found that there are obvious disparity with the analysis results from different labs, between different analytical methods, even from different types of samples, different ways of sampling, and different parts of the

same sample, which certainly has an affect on the objective understanding of shale reservoirs and the exploitation prospect in this study area. Based on the case studies of several data quality issues, some influencing factors causing the inconsistency of the shale core analysis results are discussed, such as sample types, sampling location, sampling methods and test facility. In order to reduce the impact of these factors, it is suggested that a systematic and standardized analysis procedure and robust methods for tight rock analysis from the shale core handling to standardized sampling and testing should be put forward in shale oil and gas industry. It is concluded that attention to quality issues related with shale core analysis must be paid. In addition to the scientific analysis quality assurance and quality control set up inside the laboratory, the external quality assessment and feedback from data users are also an important way for promoting and improving the quality of core analysis.  
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**Number of references:** 44

**Main heading:** Quality control

**Controlled terms:** Core analysis - Core samples - Factor analysis - Gas industry - Gases - Minerals - Petrophysics - Quality assurance - Shale - Shale gas - Test facilities

**Uncontrolled terms:** Influencing factor - Interlab comparison - Sampling location - Sampling method - Sichuan Basin

**Classification code:** 481.4 Geophysical Prospecting - 482.2 Minerals - 522 Gas Fuels - 913.3 Quality Assurance and Control - 922.2 Mathematical Statistics

**DOI:** 10.3787/j.issn.1000-0976.2020.01.021

**Database:** Compendex

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17.

**Accession number:** 20200908220885

**Title:** Dynamic change laws of the permeability of coal containing gas under the effect of coal matrix deformation

**Title of translation:** 煤基质变形影响下含瓦斯煤渗透率动态变化规律

**Authors:** Li, Xiangchun ; Huang, Tao ; Chen, Xiaolong ; An, Zhenxing ; Lu, Weidong ; Chen, Zhifeng

**Author affiliation:** College of Emergency Management and Safety Engineering, China University of Mining and Technology, Beijing; 100083, China  
Henan Provincial State Key Laboratory for Gas Geology and Gas

Control, Jiaozuo; Henan; 454000, China

College of Safety Science and Engineering, Xinjiang Institute of Engineering, Urumqi; Xinjiang; 830091, China

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**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Coal permeability not only has a direct effect on the exploitation effect of coalbed methane (commonly called gas), but also is the key parameter in the calculation of gas emission. In order to investigate the variation laws of the permeability of coal-containing gas under different pressures, it is necessary to establish a dynamic evolution model of the permeability of coal-containing gas under different pressures by considering the comprehensive effects of effective stress and gas adsorption/desorption on coal permeability. Then, a permeability measurement experiment under triaxial stress state was carried out on the coal samples taken from Yuecheng Mine Field of Shanxi Jinmei Group. Moreover, the experimental results and model calculation results were compared. Finally, the dynamic variation laws of the permeability of coal-containing gas under different pressures were discussed. And the following research results were obtained. First, the permeability-pressure relationship curve is in an irregular "U" shape. In the phase of lower pressure, as the pressure increases, the amount of the gas adsorbed by the surface of coal matrix increases, the influence of coal rock expansion deformation on the permeability is dominant and the permeability decreases rapidly. As the pressure gradually increases, the gas adsorption capacity gets saturated, the effect of effective stress on permeability gradually dominates and the permeability increases slightly. Second, the experimental results and the model calculation results are basically accordant and their variation trends are also consistent. It is concluded that the proposed dynamic evolution model for the permeability of coal-containing gas is reliable and can provide technical support for the prevention of coal and gas outburst and the effective

exploitation of coalbed methane.

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**Number of references:** 20

**Main heading:** Gas permeability

**Controlled terms:** Coal - Coal bed methane - Coal deposits - Coal mines - Deformation - Firedamp - Gas adsorption - Methane - Porosity

**Uncontrolled terms:** Coal containing gas - Coalbeds - Different pressures - Dynamic permeability - Effective stress - Methane adsorption - Methane desorption

**Classification code:** 503 Mines and Mining, Coal - 503.1 Coal Mines - 522 Gas Fuels - 524 Solid Fuels - 802.3 Chemical Operations - 804.1 Organic Compounds - 931.2 Physical Properties of Gases, Liquids and Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.01.011

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

18.

**Accession number:** 20201208317947

**Title:** High-quality development of ultra-deep large gas fields in China: Challenges, strategies and proposals

**Title of translation:** 中国超深层大气田高质量开发的挑战, 对策与建议

**Authors:** Li, Xizhe ; Guo, Zhenhua ; Hu, Yong ; Liu, Xiaohua ; Wan, Yujin ; Luo, Ruilan ; Sun, Yuping ; Che, Mingguang

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration & Development, Langfang; Hebei; 065007, China

**Source title:** Natural Gas Industry

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**Volume:** 40

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**Publication year:** 2020

**Pages:** 75-82

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Natural gas from ultra-deep reservoirs has been a major contributor for reserves boost, deliverability construction, and profits growth in natural gas industry in China. As a significant strategic domain in the future development of upstream business, the high-quality development of ultra-deep gas resources has great significance for economic benefits enhancement and sustained regional supply assurance. In this paper, based on the appraisal of development characteristics and effectiveness in the developed large ultra-deep gas fields, challenges for high quality development were indicated, which include the difficulties in structure confirm, uncertainties in reserves define and production optimization, risks of aquifer water early breakthrough and high investment of deep wells. Through indoor physical simulation experiments, reservoir characterization, performance evaluation, reservoir simulation and knowledge acquisition from analogous fields at home and abroad, the connotation and requirements for high quality development were discussed, and furthermore, strategies and proposals were thus proposed as follows: to strengthen the pre-development reservoir evaluation to define movable gas reserves and quantify rational production rate so as to avoid facility waste; to optimize both well location disposition and well flow rate to achieve uniform depletion and high EUR; to continuously enhance drilling & completion technologies to further reduce drilling and completion circle and cost and targeted reservoir stimulation technologies to enhance movable reserves and single-well productivity and increase the depletion of inferior reserves; and to innovate management modes to establish scientific programs and procedures for the construction, production and operation of ultra-deep gas fields and strictly control the upper limit index of production rate so as to emphasize quality benefits. In conclusion, high-quality development of ultra-deep gas fields, a hard and complicated system though, will be possibly achieved only by continuous innovation of exploration and development technologies and management modes.

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**Number of references:** 17

**Main heading:** Reservoir management

**Controlled terms:** Aquifers - Economics - Energy resources - Gas industry - Gases - Infill drilling - Natural gas - Natural gas well completion - Natural gas well production - Natural gas wells - Petroleum reservoir evaluation - Planning - Proven reserves - Quality control - Waste management - Well stimulation

**Uncontrolled terms:** Drilling and completion - High quality - Large gas field - Reservoir stimulations - Strategies and proposals - Ultra deeps

**Classification** 444.2 Groundwater - 511.1 Oil Field Production Operations - 512  
**code:** Petroleum and Related Deposits - 522 Gas Fuels - 525.1 Energy  
 Resources and Renewable Energy Issues - 912.2 Management -  
 913.3 Quality Assurance and Control - 971 Social Sciences

**DOI:** 10.3787/j.issn.1000-0976.2020.02.008

**Database:** Compendex

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19.

**Accession** 20201708556850  
**number:**

**Title:** Reserves grading classification and development  
 countermeasures for low-permeability tight gas reservoirs in  
 the Ordos Basin

**Title of translation:** 鄂尔多斯盆地低渗透-致密气藏储量分类及开发对策

**Authors:** Cheng, Lihua ; Guo, Zhi ; Meng, Dewei ; Ji, Guang ; Wang, Guoting  
 ; Cheng, Minhua ; Zhao, Xin

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration &  
 Development, Beijing; 100083, China

**Source title:** Natural Gas Industry

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**Volume:** 40

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**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 65-73

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Low-permeability tight gas reservoirs in the Ordos Basin are characterized by poor reservoir physical properties, strong heterogeneity, low reserves producing degree and large difference in reserves producing degree, so even though their reserves scale is large, it is still a big challenge to keep long-term stable production and efficient development. To this end, this paper took five main gas fields in the Ordos Basin as the research objects to carry out reserves evaluation unit classification, reserves grading classification and evaluation and reserves

developmental sequence establishment on low-permeability tight gas reservoirs by taking the benefit development as the orientation and the internal rate of return (IRR) as the key evaluation index, combined with dynamic and static characteristics. Furthermore, development technical countermeasures were put forward correspondingly for each type of reserves. And the following research results were obtained. First, the Ordos Basin is low in single-well dynamic reserves and gas production rate, and its gas producing patterns can be classified into two types, i.e., multiple-layer cooperative gas supply and single-layer main gas supply. Second, the five main gas fields in the Ordos Basin are divided into 11 reserves evaluation units, based on the similarity principle of geological conditions and single-well dynamic characteristics, combined with the distribution situations of development management blocks. And then by taking IRR of 30%, 8% and 5% as the boundaries, the 11 reserves evaluation units are classified into four reserves types, including high-efficiency, efficiency, low-efficiency and difficult-to-produce. Third, with IRR 8% as the threshold of effective development, the corresponding estimated ultimate reserve (EUR) per well is compared with the actual EUR per well of each reserves evaluation unit. And according to the benefit order from the top to the bottom, the cost-effective developmental sequence of the reserves evaluation units is built up. Fourth, it is suitable to apply pressurized exploitation and local well pattern adjustment to high-efficiency reserves, well pattern infilling to middle-efficiency reserves to increase the reserve producing degree, enrichment region selection and progressive development to low-efficiency reserves, and intensive technological research to difficult-to-produce reserves to realize benefit development. In conclusion, the research results are conducive to improving the producing degree of natural gas reserves in the Ordos Basin and provide technical support for the preparation of the Ordos Basin's long-term natural gas development strategy.

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**Number of references:** 19

**Main heading:** Low permeability reservoirs

**Controlled terms:** Cost effectiveness - Earnings - Efficiency - Gas industry - Gas permeability - Gas supply - Gases - Grading - Metamorphic rocks - Petroleum reservoir evaluation - Proven reserves - Tight gas

**Uncontrolled terms:** Classification and evaluations - Development countermeasures - Dynamic characteristics - Internal rate of return - Natural gas development - Reservoir physical property - Technical countermeasures - Technological researches

**Classification code:** 512.1 Petroleum Deposits - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 911.2 Industrial

Economics - 913.1 Production Engineering - 931.2 Physical Properties of Gases, Liquids and Solids

**Numerical data indexing:** Percentage 3.00e+01%, Percentage 5.00e+00%, Percentage 8.00e+00%

**DOI:** 10.3787/j.issn.1000-0976.2020.03.008

**Database:** Compendex

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20.

**Accession number:** 20201208317974

**Title:** Key technologies for the exploration and development of deep fractured-vuggy carbonate condensate gas reservoirs: A case study of the Tazhong I Gas Field in the Tarim Basin

**Title of translation:** 深层缝洞型碳酸盐岩凝析气藏勘探开发关键技术-以塔里木盆地塔中 I 号气田为例

**Authors:** Yang, Haijun ; Li, Shiyin ; Deng, Xingliang ; Yin, Guoqing ; Zhang, Chengsen ; Yang, Fengying

**Author affiliation:** Research Institute of Exploration and Development, PetroChina Tarim Oilfield Company, Korla, Xinjiang; 841000, China

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**Issue date:** February 25, 2020

**Publication year:** 2020

**Pages:** 83-89

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to achieve large-scale efficient development of deep fractured-vuggy carbonate condensate gas reservoirs, this paper took the Tazhong I Gas Field in the Tarim Basin as an example to analyze the development difficulties of deep fractured-vuggy carbonate condensate gas reservoirs based on its exploration and development practice. Then, the special exploration and development technologies with fine description of fractured-vuggy reservoir and optimized deployment of well location as the core were summarized and analyzed. And the following research

results were obtained. First, the spatial distribution of fractured-vuggy reservoirs is irregular and the reservoir is of strong heterogeneity and great burial depth, which makes it difficult to describe the reservoir precisely. What's more, as the development of condensate gas reservoirs continues, the phenomenon of retrograde condensation occurs in reservoir fluids. Due to the complexity of its reservoir space type, it is difficult to describe the occurrence state of condensate oil. The superimposed effect of these two factors makes it difficult to deploy well location optimally. Second, the three-dimensional seismic acquisition technology with "broad band, wide azimuth and high density" as the core can greatly improve the signal-to-noise ratio, resolution, and imaging accuracy of seismic data and identify the small-scale reservoirs which cannot be identified using conventional seismic acquisition technologies. Third, the fracture-vug body description technology with seismic data as the core can show the spatial distribution and development situations of fractures and vugs and realize a systematic research of a single fracture-vug body, fracture-vug unit and fracture-vug belt, laying a foundation for reserves calculation and well deployment. Fourth, the fracture-vug body and fluid identification technology with imaging logging as the core can accurately identify the fracture-vug bodies and fluids around deep carbonate wells, with a coincidence rate of interpretation result as high as 87%. Fifth, the well deployment optimization technology with the horizontal well pattern as the core can improve reservoir drilling rate and drilling success rate. And in the meantime, the trajectory of horizontal well is deployed in the middle-lower part of fracture-vug body, which can improve the primary oil and gas recovery factor greatly. Sixth, the well trajectory design optimization technology with geomechanics as the core can realize the smooth drilling and targeting of horizontal wells. It is concluded that the achieved research results provide powerful support for the efficient development of the Tazhong I Gas Field and can provide useful reference for the development of deep fractured-vuggy carbonate condensate gas reservoirs at home and abroad.

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**Number of references:** 15

**Main heading:** Gas condensates

**Controlled terms:** Carbonation - Fracture - Gas industry - Gases - Geophysical prospecting - Horizontal wells - Infill drilling - Oil well logging - Petroleum prospecting - Petroleum reservoirs - Seismic response - Seismic waves - Signal to noise ratio - Spatial distribution - Technology transfer

**Uncontrolled terms:** Carbonate rock - Condensate gas reservoirs - Deep layer - Fractured-vuggy reservoirs - Gas fields - Gas reservoir development - Tarim Basin

**Classification** 481.4 Geophysical Prospecting - 484 Seismology - 484.2

**code:** Secondary Earthquake Effects - 511.1 Oil Field Production Operations - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 716.1 Information Theory and Signal Processing - 802.2 Chemical Reactions - 921 Mathematics - 951 Materials Science

**Numerical data indexing:** Percentage 8.70e+01%

**DOI:** 10.3787/j.issn.1000-0976.2020.02.009

**Database:** Compendex

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21.

**Accession number:** 20201708556746

**Title:** Rock-breaking characteristics and temperature field change of cone-PDC hybrid bits

**Title of translation:** 牙轮-PDC 混合钻头的破岩特性及温度场变化

**Authors:** Wu, Zebing ; Lyu, Lantao ; Wang, Yongyong ; Pan, Yujie ; Zhang, Shuai

**Author affiliation:** Mechanical Engineering College, Xi'an Shiyou University, Xi'an; Shaanxi; 710065, China

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**Volume:** 40

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**Publication year:** 2020

**Pages:** 99-106

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Compared with a conventional PDC bit or a cone bit, a cone-PDC hybrid bit is better in rock breaking effect. The heat generated in the process of its rock breaking has a significant effect on its service life and drilling efficiency. So far, however, the temperature fields and rock breaking characteristics in the process of its rock breaking have not been researched thoroughly. In order to provide a theoretical support for the

optimization and popularization of a hybrid bit, this paper established a rock-breaking simulation model based on finite element analysis method, elastic-plastic mechanics, etc. And based on this, temperature field change laws and rock breaking characteristics of the hybrid bit in the process of rock breaking were analyzed. And the following research results were obtained. First, when a cone-dominated hybrid bit is used for rock breaking, the rolling cutter firstly impacts the rock to generate breaking pit and then PDC cogging carries out shearing. And when the PDC-dominated hybrid bit is used, the PDC cogging creates grooves by conducting scraping and then the rolling cutter breaks the rock. Second, the temperature of a hybrid bit rises rapidly in the initial stage of rock breaking, and after a while it tends to be stable and the temperature increases with the increase of the weight on bit (WOB). Third, compared with a PDC bit or a cone bit, a hybrid bit has a lower temperature in the process of rock breaking. The rock-broken volume of the hybrid bit is larger than the sum of a single PDC bit and a single cone bit. Fourth, the rock breaking temperature of a hybrid bit in hard strata is higher than that in soft strata, while the resulted rate of penetration (ROP) is opposite. Fifth, a bit's rock breaking temperature and rock breaking characteristics are related to its own structure. In conclusion, the research results are conducive to the design optimization, popularization and application of hybrid bits. © 2020, Natural Gas Industry Journal Agency. All right reserved.

**Number of references:** 24

**Main heading:** Rocks

**Controlled terms:** Bits - Diamond drills - Elastoplasticity - Temperature

**Uncontrolled terms:** Design optimization - Drilling efficiency - Finite element analysis method - Lower temperatures - Rate of penetration - Simulation model - Temperature field change - Temperature increase

**Classification code:** 603.2 Machine Tool Accessories - 641.1 Thermodynamics

**DOI:** 10.3787/j.issn.1000-0976.2020.03.012

**Database:** Compendex

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22.

**Accession number:** 20201208317054

**Title:** A comprehensive logging evaluation method of shale gas reservoir quality

**Title of translation:** 页岩气储层品质测井综合评价

**Authors:** Zhong, Guanghai ; Chen, Liqing ; Liao, Maojie ; Wang, Guangyao ; Yang, Yang ; Gao, Xiang

**Author affiliation:** Research Institute of Shale gas, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610041, China  
Shale Gas Evaluation and Exploitation Key Laboratory of Sichuan Province, Chengdu; Sichuan; 610041, China

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**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Publication year:** 2020

**Pages:** 54-60

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**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** As a crucial factor for reservoir fracturing reconstruction, the quality of a shale reservoir could directly affect the optimization of a testing zone, the effectiveness of fracturing operation, and the level of shale gas test productivity. To this end, a case study was made on the comprehensive evaluation of marine shale reservoirs in the southern Sichuan. First, through correlation analysis of core laboratory data and well logging curves, uranium content and density curves were chosen to calculate the total organic carbon, acoustics, density and uranium curves to calculate reservoir porosity and organic porosity, and a multi-parameter model for calculating shale reservoir parameters was thus established with high precision. Second, based on the principal component method analysis between reservoir parameters and single-stage test production in horizontal wells, shale porosity, total organic carbon, brittleness index and total gas content were chosen to establish a comprehensive evaluation model for horizontal wells in shale reservoirs, and to set up a comprehensive method to evaluate shale quality by using log data, from which evaluation results and production logging results were found to have a good correspondence. This study suggests that acoustics curves can better characterize inorganic porosity, while uranium content can better characterize organic shale porosity; and that a horizontal well target should be controlled as far as possible in the single layer with a high brittle mineral content and a high brittle index, i. e., easier to be fractured and more complex fractures to be formed, the greater the contribution of test

production. It is concluded that the logging evaluation method of a shale gas horizontal well could precisely indicate the quality of shale reservoirs, providing a technical support for target optimization of field horizontal wells and fracturing section optimization of high quality shale reservoirs, and effectively guide field production and development practices.

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**Number of references:** 17

**Main heading:** Quality control

**Controlled terms:** Acoustic logging - Brittleness - Fracture - Fracture mechanics - Gases - Horizontal wells - Marine engineering - Organic carbon - Petroleum reservoir evaluation - Petroleum reservoirs - Plasticity - Porosity - Porous carbon - Principal component analysis - Shale gas - Uranium

**Uncontrolled terms:** Gas content - Marine shales - Organic carbon contents - Reservoir quality - Sichuan Basin

**Classification code:** 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 547 Minor, Precious and Rare Earth Metals and Alloys - 675 Marine Engineering - 751.2 Acoustic Properties of Materials - 804.1 Organic Compounds - 913.3 Quality Assurance and Control - 922.2 Mathematical Statistics - 931.1 Mechanics - 931.2 Physical Properties of Gases, Liquids and Solids - 951 Materials Science

**DOI:** 10.3787/j.issn.1000-0976.2020.02.006

**Database:** Compendex

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23.

**Accession number:** 20200908220918

**Title:** Construction of China's oil & gas exploration and development supervision system under the new situation

**Title of translation:** 新形势下中国油气勘探开发监管体系的构建

**Authors:** Tang, Guoqiang ; Xu, Dong ; Fu, Di ; Liu, Tao

**Author affiliation:** China University of Petroleum, Beijing, Beijing; 102249, China  
PetroChina Planning and Engineering Institute, Beijing; 100083, China  
Tianjin University, Tianjin; 300072, China  
China Petroleum Materials Procurement Center, Beijing; 100029, China

**Corresponding author:** Xu, Dong (xudong@petrochina.com.cn)

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**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Some Opinions on Deepening Reform of Oil and Natural Gas System issued by the state proposes that an oil and natural gas system with orderly competition, legal compliance and effective supervision be established. At present, however, China's oil & gas exploration and development field lacks independent supervision and regulation. And its supervision functions are absent or scattered, its supervision work needs to be improved and its supervision power is seriously insufficient, which restricts the healthy and efficient development of oil and gas industry. In view of this, the reform history and management and supervision status of China's oil and gas industry were systematically investigated. Then, combined with the main enlightenments of foreign oil & gas exploration and development supervision, the following suggestions were proposed to improve domestic oil & gas exploration and development supervision system. First, government management institutions and functions should be gradually rationalized; oil & gas exploration and development supervision methods should be optimized; relatively independent professional regulatory agencies should be established and a hierarchical supervision system with clear powers and responsibilities and coordination and cooperation should be constructed. Second, the construction of oil & gas exploration and development supervision system shall adhere to ten basic principles, such as coordinating and promoting the reform of government functions, serving the industrial development and energy strategic goals and forming a diversified supervision system. Third, a modern supervision system of "clear laws, well-defined power and responsibility, efficiency and transparency, openness and fairness, and multi-participation" should be constructed, with the supervision operation focusing on three aspects, i.e., safety and production supervision, market supervision and industry regulation. Fourth, the construction of the institutional mechanism of regulatory agencies shall follow

the basic ideas of "short board complementation and function enhancement" in the 13 Five-Year Plan period, "mechanism construction and separation promotion" in the earlier stage of 14 Five-Year plan period, and "large department system and hierarchical supervision" in the later stage of 14 Five-Year Plan period. Fifth, special reform leading groups and working groups should be set up to improve the system of laws, regulations and rules, and comprehensively coordinate the relationship between the governments of all levels and the industry sectors, producers and consumers, giving full play to the supervision of oil and gas companies and industry associations.

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**Number of references:** 24

**Main heading:** Petroleum prospecting

**Controlled terms:** Accident prevention - Gas industry - Gases - Geological surveys - Laws and legislation - Natural gas - Natural gasoline plants - Oil field development - Public utilities

**Uncontrolled terms:** Coordination and cooperation - Diversified supervision - Gas exploration - Hierarchical supervision - Large department system - Reform

**Classification code:** 481.1 Geology - 512.1.2 Petroleum Deposits : Development Operations - 513.2 Petroleum Refineries - 522 Gas Fuels - 914.1 Accidents and Accident Prevention - 971 Social Sciences

**DOI:** 10.3787/j.issn.1000-0976.2020.01.019

**Database:** Compendex

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24.

**Accession number:** 20202508844939

**Title:** Integrated geosteering technology for CQ-IGS horizontal wells and its application in the Changning-Weiyuan National Shale Gas Demonstration Area

**Title of translation:** CQ-IGS水平井一体化地质导向技术-以在长宁-威远国家级页岩气示范区的应用为例

**Authors:** Shi, Jingsuicui ; He, Ying ; Wu, Zongwei ; Wang, Hao ; Chen, Ming ; Fu, Jinxiang ; Liao, Qiming ; Liu, Ming ; Hong, Bing

**Author affiliation:** Geological Exploration & Development Research Institute, CNPC Chuanqing Drilling Engineering Co. Ltd., Chengdu; Sichuan; 610051, China  
Chengdu Chuandachuanke Network Information Co. Ltd., Chengdu; Sichuan; 610041, China

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**Pages:** 43-49

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Geosteering technique is one of the core technologies in the drilling of shale-gas horizontal wells, but the conventional method only based on logging while drilling data cannot meet the needs of rapid commercial development of shale gas. To control the trajectory of horizontal wells accurately, this paper established a fine 3D geosteering model using the high-resolution 3D seismic data volume processing technique, combined with the independently developed Chuanqing-Integrated Geo-Steering (CQ-IGS) software platform. In this software platform, integrated processing and interpretation was carried out on 3D seismic, logging while drilling and compound mud logging. The horizontal well trajectory was controlled accurately by means of cuttings identification and component analysis technique. In this way, a horizontal well integrated geosteering technique was developed. Its application in 187 wells in the Changning-Weiyuan National Shale Gas Demonstration Area of the Sichuan Basin during 2011-2018 shows that the drilling time of the horizontal section of each horizontal well is shortened from 35 d to 25 d in 2018; the average target drilling rate per well is 96.7%; the average optimal geological sweet spot drilling rate per well is increased from 35.3% in 2014 to 91.0% in 2018; the average daily production per well is increased from 11.5×10 m to 15.5×10 m in the Weiyuan Shale Gas Block and from 14.0×10 m to 18.5×10 m in the Changning Shale Gas Block. In conclusion, this technique reasonably optimizes drilling trajectory, shortens drilling cycle, reduces drilling cost, and remarkably improves target-encountered drilling rate and single-well production rate.

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**Number of references:** 16

**Main heading:** Logging while drilling

**Controlled terms:** 3D modeling - Data handling - Gases - Horizontal wells -

Infill drilling - Mud logging - Seismology - Shale gas - Trajectories

**Uncontrolled terms:** Commercial development - Component analysis - Conventional methods - Daily production - Horizontal section - ITS applications - Single well production - Software platforms

**Classification code:** 484.1 Earthquake Measurements and Analysis - 511.1 Oil Field Production Operations - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 723.2 Data Processing and Image Processing

**Numerical data indexing:** Percentage 2.01e+03% to 9.10e+01%, Percentage 3.53e+01%

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25.

**Accession number:** 20203509114444

**Title:** A material balance based practical analysis method to improve the dynamic reserve evaluation reliability of ultra-deep gas reservoirs with ultra-high pressure

**Title of translation:** 提升超深层超高压气藏动态储量评价可靠性的新方法-物质平衡实用化分析方法

**Authors:** Sun, Hedong ; Cao, Wen ; Li, Jun ; Jia, Wei ; Li, Yuanjie ; Wu, Yan ; Zhu, Songbai ; Fu, Xiaotao ; Yang, Min ; Meng, Guangren

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration & Development, Langfang; Hebei; 065007, China  
PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China

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**Publication year:** 2020

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**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Ultra-deep major gas fields are typically characterized by high and ultra-high pressure, tight matrix and developed fractures, so the dynamic reserve estimation is of higher uncertainty. In order to accurately estimate the dynamic reserves of this type of gas reservoir, this paper analyzed the correlation between the effective rock compressibility and the cumulative effective rock compressibility based on the material balance equation of high and ultra-high pressure gas reservoirs, and accordingly selected the material balance based analysis method suitable for the dynamic reserves estimation of high and ultra-high pressure gas reservoirs. Then, the starting calculation conditions of dynamic reserve estimation were determined using the non-linear regression method. In addition, a semi-logarithmic type curve matching method was established for the cases where the starting conditions could not be met. Finally, this method was applied to calculate the dynamic reserves of three ultra-high pressure gas fields (reservoirs) to verify its reliability. And the following research results were obtained. First, the cumulative effective compressibility of gas reservoir in the material balance equation of high and ultra-high pressure gas reservoir is a key parameter influencing its dynamic reserves, and it is the function of original formation pressure and current average formation pressure, but its numerical value can be hardly obtained by core experiments. Second, it is recommended to adopt the nonlinear regression method without compressibility to estimate the reserves of high and ultra-high pressure gas reservoirs. Third, the calculation starting point of dynamic reserves by the nonlinear regression method (the starting point of dimensionless apparent formation pressure-cumulative gas production curve deviating from the straight line relationship) cannot be theoretically calculated. The calculation starting point for different dimensionless linear coefficients ( $\omega D$ ) obtained from the statistical results by the graphic method corresponds to the dimensionless apparent pressure depletion degree of 0.06-0.38, and that obtained based on the data statistics of the example gas reservoir falls within this interval. Fourth, when the starting conditions are not satisfied, the semi-logarithmic type curve matching method can be used for reserve estimation. The ratio of the dynamic reserves to the apparent geological reserves  $G/G_{app}$  is a function of  $\omega D$ . The higher the  $\omega D$ , the lower the  $G/G_{app}$ . Fifth, for the high and ultra-high pressure gas reservoirs in the production test stage, the test production time shall be extended as long as possible to improve the reliability of dynamic reserve estimation. And for those in the middle and late stages of development, it is necessary to prepare the comprehensive treatment measures on the basis of dynamic reserves so as to improve the development effects of gas reservoirs continuously.

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**references:****Main heading:** Proven reserves**Controlled terms:** Compressibility of gases - Curve fitting - Gas industry - Gases - Graphic methods - High pressure engineering - Petroleum reservoir evaluation - Petroleum reservoirs - Regression analysis - Reliability analysis**Uncontrolled terms:** Cumulative gas productions - Geological reserves - Linear coefficients - Material balance equation - Non-linear regression method - Reserves estimations - Rock compressibility - Ultra-high pressure gas reservoir**Classification code:** 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 921.6 Numerical Methods - 922.2 Mathematical Statistics - 931.2 Physical Properties of Gases, Liquids and Solids**DOI:** 10.3787/j.issn.1000-0976.2020.07.006**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

26.

**Accession number:** 20203509114470**Title:** Integrity analysis method of multi-packer string in HTHP gas wells and its application cases**Title of translation:** 高温高压气井多封隔器管柱完整性分析方法及应用实例**Authors:** Liu, Hongtao ; Shen, Xinpu ; Liu, Shuang ; Shen, Guoyang ; Qin, Shiyong ; Shen, Guoxiao**Author affiliation:** PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China  
China University of Petroleum-East China, Qingdao; Shandong; 266580, China**Corresponding author:** Shen, Xinpu (xinpushen@yahoo.com)**Source title:** Natural Gas Industry**Abbreviated source title:** Natur. Gas Ind.**Volume:** 40**Issue:** 7**Issue date:** July 25, 2020**Publication year:** 2020**Pages:** 83-89**Language:** Chinese

**ISSN:** 10000976**CODEN:** TIGOE3**Document type:** Journal article (JA)**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to analyze and calculate the mechanical behavior of multi-packer string and to evaluate the integrity of packer, this paper took the integrity of a double-packer string system under the loading conditions of fracturing construction as the research object to advance a comprehensive analysis method which combines the full-length string mechanics analysis with the 3D finite element analysis of packer's mandrel. In addition, the related analysis and calculation workflow was provided. A case study was carried out on the elastoplastic mechanics of Well Dixi 1 in the Tarim Basin. Firstly, 3D finite element analysis was performed on the entire pipe string in the full length to figure out the stress distribution along the pipe string. Then, 3D solid element was used to analyze stress distribution and elastoplastic strain distribution in the local structure of packer's mandrel to determine the operation safety of double-packer pipe string. And the following research results were obtained. First, under the action of gravity, hydraulic pressure and temperature stress, the axial stress on each part of the string is tensile stress, which is in the scope of elastic stress. Second, under the joint action of axial stress and hydraulic pressure, the mandrel suffers obvious plastic deformation. Third, in order to alleviate the excessive axial tensile stress induced by the temperature drop caused by fracturing construction, an expansion joint shall be installed between two packers. In conclusion, the numerical results of the deformation and stress distribution of multi-packer string calculated by this method are well accordant with the actual situations, which verifies the effectiveness and practicability of this method.  
© 2020, Natural Gas Industry Journal Agency. All right reserved.

**Number of references:** 17**Main heading:** Finite element method**Controlled terms:** Elastoplasticity - Hydraulic fluids - Numerical methods - Packers - Stress concentration - Tensile stress**Uncontrolled terms:** 3D-finite element analysis - Analysis and calculations - Comprehensive analysis methods - Deformation and stress - Elastoplastic strain - Fracturing construction - Hydraulic pressure - Mechanical behavior**Classification code:** 511.2 Oil Field Equipment - 921.6 Numerical Methods**DOI:** 10.3787/j.issn.1000-0976.2020.07.010**Database:** Compendex

27.

**Accession number:** 20201708556855

**Title:** Seepage mechanism and development characteristics of high and ultra-high pressure carbonate gas reservoirs: A case study from the M Block of the Amu Darya Basin

**Title of translation:** 高压-超高压碳酸盐岩气藏渗流机理及开发特征--以阿姆河盆地M区为例

**Authors:** Zhang, Li ; Liu, Ronghe ; Leng, Youheng ; Cai, Kunchi ; Gao, Yijun ; Meng, Zhonghua ; Liu, Yuanyuan

**Author affiliation:** Geology Exploration and Development Research Institute, CNPC Chuanqing Drilling Engineering Co., Ltd., Chengdu; Sichuan; 610051, China  
PetroChina - Turkmenistan Amu Darya River Gas Company, Beijing; 100000, China  
Exploration and Development Research Institute, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610041, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 3

**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 92-98

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to understand the root causes that affect the production performance of high and ultra-high pressure gas wells, this paper selected multiple cores from the carbonate gas reservoirs in the M Block of the Amu Darya Basin, Turkmenistan to carry out multi-round stress sensitivity experiments under variable confining pressure, depletion development experiments, CT scanning experiments and three-dimensional digital core simulation experiments. Then, the production characteristics of high and ultra-high pressure gas wells were analyzed in detail, and the effects of fractures of different occurrences and their development degrees on gas well productivity were studied.

Finally, reasonable development countermeasures for the high and ultra-high pressure gas reservoirs in the carbonate gas field of the M Block in the early development stage were put forward. And the following research results were obtained. First, stress sensitivity experiments show that the stress sensitivity of porous and vuggy cores is moderately weak and that of fractured-porous cores is strong. In addition, the irreversible permeability damage rate is high and mainly concentrated in the initial stage of pressurization. Second, the elastic expansion of rocks is the main drive energy in the early exploitation stage of high and ultra-high pressure gas reservoirs. Third, as for high and ultra-high pressure gas reservoirs, it is necessary to control the gas production rate in the early stage of development, which is beneficial to reduce the decline amplitude of gas well productivity and increase the intermediate degree of reserve recovery. Fourth, the initial productivity of the gas wells in fractured-porous reservoirs is mainly affected by the fracture development degree, and the decline amplitude of gas well productivity is mainly dominated by the fracture occurrence. Fifth, for the reservoirs dominated by the low-angle fractures, after the formation pressure drops, the fractures get closed easily and the gas well productivity decreases rapidly. Therefore, the production pressure difference shall be strictly controlled in the early stage of development. Sixth, before the formation pressure drops to 45 MPa, it is necessary to keep the production pressure difference of most gas wells in the high and ultra-high pressure gas reservoirs of the Amu Darya Basin less than 5 MPa. It is concluded that the newly established method has certain generality and can provide reference for the optimal development of high and ultra-high pressure gas reservoirs in the other regions.

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**Number of references:** 20

**Main heading:** High pressure effects

**Controlled terms:** Carbonation - Computerized tomography - Drops - Fracture - Gas industry - Gases - Hydrocarbon seepage - Natural gas well production - Natural gas wells - Oil field development - Petroleum reservoirs - Pressure drop - Productivity - Proven reserves

**Uncontrolled terms:** Development characteristics - Development countermeasures - Fractured-porous reservoirs - Production characteristics - Production pressure differences - Ultra - high pressure gas wells - Ultra-high pressure gas reservoir - Variable confining pressures

**Classification code:** 512 Petroleum and Related Deposits - 522 Gas Fuels - 723.5 Computer Applications - 802.2 Chemical Reactions - 951 Materials Science

**Numerical data** Pressure 4.50e+07Pa, Pressure 5.00e+06Pa

**indexing:****DOI:** 10.3787/j.issn.1000-0976.2020.03.011**Database:** Compendex

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28.

**Accession number:** 20202908937811**Title:** **Genealogy construction of oil & gas exploration and development technological products in China****Title of translation:** 我国油气勘探开发技术产品谱系构建**Authors:** Jiang, Zi'ang ; Gu, Sui ; Wang, Jing ; Ren, Limei ; Liu, Weidong ; Peng, Bin ; Ma, Yingkai

**Author affiliation:** Natural Gas Economic Research Institute, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China  
 Tight Oil & Gas Exploration and Development Project Division, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China  
 Communications and Information Technology Center, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China  
 CNPC Chuanqing Drilling Engineering Co., Ltd., Chengdu; Sichuan; 610051, China

**Source title:** Natural Gas Industry**Abbreviated source title:** Natur. Gas Ind.**Volume:** 40**Issue:** 6**Issue date:** June 25, 2020**Publication year:** 2020**Pages:** 149-156**Language:** Chinese**ISSN:** 10000976**CODEN:** TIGOE3**Document type:** Journal article (JA)**Publisher:** Natural Gas Industry Journal Agency**Abstract:** The technological processes and systems of oil & gas exploration and development industry are complex in structure, huge in quantity and great in investment risk. The basic work of technological resource management is weak, so technological rank order and function empowerment have been the bottlenecks

of single technological value assessment, which seriously restricts both technological value evaluation and technological development strategy implementation in this industry. Based on genealogical theories and thoughts, this paper constructed the rank order and quantity genealogy of oil & gas exploration and development technology under the guidance of technological valuation and commercialization. Then, natural gas exploration and development technology was taken as an example to design and construct the rank order genealogy of natural gas exploration and development technology in the pattern of 5 geometric series and four rank orders. And the following research results were obtained. First, genealogical development of oil & gas technologies will be an inevitable trend of oil & gas technological resource management. Second, the construction of oil & gas technological product genealogy is a basic relationship index for describing the technological system and its rank order, and it is also a tool for sharing technological innovation achievements effectively and a key tool for verifying the share percentage of technological innovation achievements. Third, deeply exploring the construction of oil & gas technological genealogy will be conducive to expanding the popularization, application and market development of oil & gas technologies and promote the valuation of technological innovation achievements. In conclusion, the technological product genealogy constructed in this paper can not only describe the whole natural gas exploration and development technology system and the basic energy-level relationship between the technologies and realize the resource matching between technological innovation and technological market, but find out the basic function "positions" of innovative technologies to deal with technological innovation and efficiency capacity empowerment, share radix and other problems.

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**Number of references:** 19

**Main heading:** Petroleum prospecting

**Controlled terms:** Commerce - Gas industry - Gases - Geological surveys - History - Investments - Natural gas - Natural gas deposits - Natural resources management - Resource allocation

**Uncontrolled terms:** Innovative technology - Natural gas exploration - Product genealogies - Technological development - Technological innovation - Technological process - Technological resources - Technological system

**Classification code:** 481.1 Geology - 512.1.2 Petroleum Deposits : Development Operations - 512.2 Natural Gas Deposits - 522 Gas Fuels - 912.2 Management - 971 Social Sciences

**DOI:** 10.3787/j.issn.1000-0976.2020.06.016

**Database:** Compendex

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29.

**Accession number:** 20202908937849

**Title:** Genetic mechanism of high-quality shale gas reservoirs in the Wufeng-Longmaxi Fms in the Sichuan Basin

**Title of translation:** 四川盆地五峰组-龙马溪组页岩气优质储层成因机制

**Authors:** Nie, Haikuan ; He, Zhiliang ; Liu, Guangxiang ; Du, Wei ; Wang, Ruyue ; Zhang, Guangrong

**Author affiliation:** State Key Laboratory of Shale Oil & Gas Enrichment Mechanisms and Effective Development, Beijing; 100083, China  
Sinopec Key Laboratory of Shale Oil/Gas Exploration & Production, Beijing; 100083, China  
PetroChina Research Institute of Petroleum Exploration & Production, Beijing; 100083, China  
Department of Science and Technology, China Petroleum & Chemical Corporation, Beijing; 100728, China  
School of Energy Resource, China University of Geosciences, Beijing; 100083, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 6

**Issue date:** June 25, 2020

**Publication year:** 2020

**Pages:** 31-41

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The Upper Ordovician Wufeng Formation and the Lower Silurian Longmaxi Formation are important strata for shale gas exploration and development in the Sichuan Basin, but the genetic mechanism, evolutionary history and the controlling effect of mineral diagenetic evolution on the formation of shale gas reservoirs are not clear. In this paper, the evolution history of organic matter pores and the diagenetic evolution of minerals were analyzed based on the analysis of petrology, mineralogy and

organic geochemistry, combined with basin simulation and practical shale gas exploration and development. Then, the types and genetic mechanisms of high-quality shale gas reservoirs were discussed, and the development intervals of high-quality shale gas reservoirs were determined. And the following research results are obtained. First, the shale gas development intervals of Wufeng-Longmaxi Fm in the Sichuan Basin are mainly dominated by siliceous shale, limy siliceous shale and clay shale. Rock type has an important controlling effect on the types and characteristics of shale reservoir space. Siliceous shale and limy siliceous shale have the highest reservoir capacity with the most developed organic pores. Second, the diagenetic evolution of minerals controls the formation of shale gas reservoirs. Biogenic silicon, was formed in the early diagenetic stage, together with terrestrial detrital silicon and pyrite, constitutes particle support lattices in the form of microcrystalline aggregates, so as to resist the compaction effectively and preserve a great number of residual intergranular pores, which is beneficial to the formation of high-quality shale gas reservoirs. Third, siliceous shale in the WF2-LM4 graptolite zone (from Wufeng Formation to the bottom of Longmaxi Formation) presents a high-quality reservoir genetic mechanism of "multicellular algae controlling hydrocarbon source, biogenic silicon controlling framework, and co-evolution controlling a high-quality reservoir". In conclusion, the siliceous shale and limy siliceous shale in the WF2-LM4 graptolite zone are the main development intervals of high-quality shale gas reservoirs.

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**Number of references:** 42

**Main heading:** Quality control

**Controlled terms:** Gases - Geochemistry - Geological surveys - Microcrystals - Mineral exploration - Organic minerals - Petroleum prospecting - Petroleum reservoirs - Pyrites - Shale gas - Textures

**Uncontrolled terms:** Diagenetic evolution - Evolutionary history - High quality reservoir - Hydrocarbon sources - Intergranular pores - Organic geochemistry - Reservoir capacity - Shale gas reservoirs

**Classification code:** 481.1 Geology - 481.2 Geochemistry - 482.2 Minerals - 501.1 Exploration and Prospecting Methods - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 913.3 Quality Assurance and Control - 933.1 Crystalline Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.06.003

**Database:** Compendex

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30.

**Accession number:** 20203509114405

**Title:** Anchoring mechanical behavior of packer slips and its HTHP experimental analysis

**Title of translation:** 封隔器卡瓦锚定力学行为与高温高压实验分析

**Authors:** Han, Chuanjun ; Peng, Xuefeng ; Li, Lintao

**Author affiliation:** Key Laboratory of Oil and Gas Equipment, Ministry of Education, Southwest Petroleum University, Chengdu; Sichuan; 610500, China  
Sinopec Northwest Oilfield Company, Urumqi; Xinjiang; 830011, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 7

**Issue date:** July 25, 2020

**Publication year:** 2020

**Pages:** 76-82

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The setting performance of a packer is directly affected by the anchoring effect of a packer slip on the casing. When the slip is embedded into the casing, bite marks can be formed on the casing contact surface, and excessive embedded depth may lead to casing damage and failure. To ensure that slips perform a good packer fixing function while reducing the damage to the casing, this paper adopted the slip line theory, finite element analysis method and experimental method to study the mechanical behavior of slips in the process of anchoring and calculated the embedded depth of the slip in the casing. In addition, influences of slip thread angle, inclination angle, inner cone angle and axial load on the anchoring were analyzed, and structural parameters were optimized. And the following research results were obtained. First, the stress distribution on the casing contact surface is uneven, which results in stress concentration. Second, the stress of slip tooth decreases gradually as the number of teeth increases. Third, the embedded depth of the slip tooth in the casing increases with the increase of load, but decreases

gradually with the increase of the number of teeth. Fourth, under the same load, the embedded depth of the slip in the casing decreases with the increase of thread angle and inner cone angle, but increases with the increase of inclination angle. Fifth, slip anchoring and packer setting experiment under high temperature and high pressure shows that the maximum embedded depth of the slip in the casing is between 0.40 mm and 0.45 mm. In conclusion, experimental results and finite element simulation results are better consistent, which verifies the correctness and reliability of the design and analysis.

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**Number of references:** 18

**Main heading:** Finite element method

**Controlled terms:** Packers - Reliability analysis - Stress concentration

**Uncontrolled terms:** Design and analysis - Experimental analysis - Experimental methods - Finite element analysis method - Finite element simulations - High temperature and high pressure - Mechanical behavior - Structural parameter

**Classification code:** 511.2 Oil Field Equipment - 921.6 Numerical Methods

**Numerical data indexing:** Size 4.00e-04m to 4.50e-04m

**DOI:** 10.3787/j.issn.1000-0976.2020.07.009

**Database:** Compendex

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31.

**Accession number:** 20203509114420

**Title:** **New breakthrough of natural gas exploration in the Qixia Formation of Middle Permian by Well Pingtan 1 in the southwestern Sichuan Basin and its implications**

**Title of translation:** 四川盆地西南部平探1井中二叠统栖霞组天然气勘探新突破及其意义

**Authors:** Zhang, Benjian ; Yin, Hong ; Li, Rongrong ; Xie, Chen ; Wang, Xiaoxing ; Pei, Senqi ; Hu, Xin ; Yang, Hua ; Deng, Bo ; Chen, Xiao ; Li, Xucheng

**Author affiliation:** Northwest Sichuan Division, PetroChina Southwest Oil & Gasfield Company, Jiangyou; Sichuan; 621741, China  
Exploration and Development Research Institute, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China  
Exploration Department, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 7

**Issue date:** July 25, 2020

**Publication year:** 2020

**Pages:** 34-41

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In 2020, Well Pingtan 1 in the southwestern Sichuan Basin drills into porous dolomite reservoirs of marginal platform belt in the Qixia Formation of Middle Permian and produces high-yield industrial gas, which indicates a new breakthrough of Middle Permian natural gas exploration in this area. In order to further understand the geological conditions of Qixia Formation and provide guidance for the natural gas exploration in this area, this paper studied hydrocarbon accumulation elements of this area (e.g. hydrocarbon source conditions, reservoir characteristics and preservation conditions) after analyzing the drilling results of Well Pingtan 1. Then, exploration potential and direction of Qixia Formation natural gas in this area were discussed. And the following research results were obtained. First, the Qixia Formation reservoirs in the southwestern Sichuan Basin are dominated by moderate and fine crystalline dolomite, and their reservoir spaces are mainly acted by dissolved vugs, intercrystalline pores, intergranular pores and fractures. They are fractured-porous reservoirs of low porosity and middle-low permeability, with locally developed high-porosity and high-permeability reservoirs. Their lateral distribution is controlled by marginal platform shoal and they are extensively distributed in the area of Qiongxi, Pingluoba, Mingshan and Hanwangchang. Second, the source rocks of Qixia Formation natural gas in this area are similar to those in Shuangyushi structure, and they are mainly composed of mud shale of Lower Cambrian Qiongzhusi Formation and marl of Middle Permian, among which the Qiongzhusi Formation is dominant. Third, this area is characterized by "double-layer structure" vertically, and the Triassic salt gypsum has regional sealing conditions and the Permian structural traps and structural-lithological traps are morphologically completed with good preservation conditions, which provide favorable sites for the accumulation of Qixia

Formation natural gas. In conclusion, the Middle Permian in the southwestern Sichuan Basin is better in hydrocarbon accumulation conditions, and the breakthrough of Well Pingtan 1 reveals a good natural gas exploration potential of Qixia Formation dolomite reservoirs of marginal platform belt in the southwestern Sichuan Basin.

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**Number of references:** 19

**Main heading:** Petroleum prospecting

**Controlled terms:** Crystallography - Fertilizers - Gases - Geological surveys - Hydrocarbons - Infill drilling - Lithology - Low permeability reservoirs - Natural gas - Natural gas well drilling - Natural gas wells - Petroleum reservoir engineering - Porosity - Textures

**Uncontrolled terms:** Double layer structure - Exploration potential - High permeability reservoirs - Hydrocarbon accumulation - Intercrystalline pores - Natural gas exploration - Preservation condition - Reservoir characteristic

**Classification code:** 481.1 Geology - 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 522 Gas Fuels - 804 Chemical Products Generally - 804.1 Organic Compounds - 931.2 Physical Properties of Gases, Liquids and Solids - 933.1 Crystalline Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.07.004

**Database:** Compendex

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32.

**Accession number:** 20202508844967

**Title:** Application of electric drive fracturing equipment in shale gas reservoir stimulation

**Title of translation:** 电驱压裂设备在页岩气储层改造中的应用

**Authors:** Zhang, Bin ; Li, Lei ; Qiu, Yongchao ; Dai, Qiping ; Li, Shuangpeng ; Deng, Youchao

**Author affiliation:** CNPC Baoji Oilfield Machinery Co., Ltd., Baoji; Shaanxi; 721002, China

National Engineering Research Center of Oil and Gas Drilling Equipment, Baoji; Shaanxi; 721002, China

Southwest Jiaotong University, Chengdu; Sichuan; 610031, China

CNPC Chuanqing Drilling Engineering Co. Ltd., Chengdu; Sichuan; 610051, China

PetroChina Southwest Oil & Gasfield Company, Chengdu;

Sichuan; 610051, China

**Corresponding author:** Li, Lei (bslil@cnpc.com.cn)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 5

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**Publication year:** 2020

**Pages:** 50-57

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Fracturing equipment is the core device in shale gas reservoir stimulation. As domestic shale gas exploration and development steps into deep layers, the development of fracturing technology puts forward higher requirements for relevant equipment. Electric drive is an important development direction of fracturing equipment technology. In this paper, the technical progress of electric drive fracturing equipment in China and abroad was investigated. It is shown that a high-power frequency conversion system is the key technology to determine the performance of electric drive fracturing equipment. After the adaptability of the high-power frequency conversion technology to electric fracturing equipment was analyzed, based on the fracturing operation of Model 2500 electric drive fracturing trucks in the Weiyuan Block of the Sichuan Basin for shale gas reservoir stimulation, electric drive and diesel-driven fracturing equipments were comparatively analyzed from the aspects of economical and technical indicators. And the following research results were obtained. First, compared with a diesel-driven fracturing truck of the same power, an electric drive fracturing truck can realize a full power coverage and a continuous adjustment of output displacement, and can better meet the operation requirements of fracturing process for a precise control of the pumping displacement, while reducing the power cost by 68% and the equipment purchase cost by 10-20%. Second, compared with the skid mounted equipment, an electric drive fracturing truck has a better transport performance, being suitable for the fracturing well sites with poor road conditions, such as loess gullies, hills and mountains. It is suggested that the following development direction of the electric drive fracturing equipment should focus

on the improvement of single machine power density. In addition, it is recommended to enhance the basic studies on high-pressure and high-power semiconductor devices and make a good plan for the power demand of shale gas platform construction in advance, so as to give a better play to the operating cost advantage of electric drive fracturing equipments.

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**Number of references:** 18

**Main heading:** Electric drives

**Controlled terms:** Construction equipment - Diesel engines - Electric control equipment - Fracture - Gases - Geological surveys - Petroleum prospecting - Petroleum reservoirs - Semiconductor devices - Shale gas - Truck transportation - Trucks

**Uncontrolled terms:** Development directions - Equipment technology - Fracturing operations - High-power semiconductor devices - Pumping displacements - Shale gas reservoirs - Technical indicator - Transport performance

**Classification code:** 405.1 Construction Equipment - 432.3 Cargo Highway Transportation - 481.1 Geology - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 612.2 Diesel Engines - 663.1 Heavy Duty Motor Vehicles - 704.2 Electric Equipment - 714.2 Semiconductor Devices and Integrated Circuits - 951 Materials Science

**Numerical data indexing:** Percentage 1.00e+01% to 2.00e+01%, Percentage 6.80e+01%

**DOI:** 10.3787/j.issn.1000-0976.2020.05.006

**Database:** Compendex

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33.

**Accession number:** 20202908937806

**Title:** A new method for calculating apparent formation dips based on strata rotation

**Title of translation:** 基于地层旋转的地层视倾角计算新方法-应用于水平井地质导向

**Authors:** Xie, Fei ; Wang, Yun ; Mei, Junwei ; Chen, Zhenlong

**Author affiliation:** Research Institute of Exploration and Development, Sinopec East China Branch, Nanjing; Jiangsu; 210011, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 6

**Issue date:** June 25, 2020

**Publication year:** 2020

**Pages:** 61-68

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** With the gradual deepening of shale gas exploration and development and increasing development scale, horizontal well geosteering technologies will be highly required to achieve more accurate geological guidance with the adjustment of drilling trajectory so as to make the horizontal track pass through high-quality reservoir sections. In this regard, a new method for calculating apparent formation dips was proposed, which revolves the strata in a three-dimensional space and takes the highest matching degree of feature points on the logging curves as the principle, and it was applied to the geosteering of horizontal wells. Based on the principle of equal thickness correlation, by this new method the calculation of apparent formation dips is transformed into a global optimization process, and a two-stage method suitable for this new method was also introduced. Compared with those conventional methods, this new method has the following advantages. First, in the case of large-angle torsional orientation and unknown formation dips before the target enters, the apparent formation dips of horizontal sections can be calculated accurately, so can be both stratigraphic tendencies and true dips at the same time. Second, if the vertical thickness of a horizontal well is quite different from that of a selected standard well, and the true thickness of the strata is unknown, the apparent formation dips can be calculated stably and effectively. The tested results from field practices demonstrate that the introduced two-stage method can accurately calculate the comprehensive stratigraphic tendency under the condition of large angle torsion orientation, and the apparent formation dips in the horizontal sections, which is consistent with the actual data. In conclusion, this new method is more suitable especially for the case that the difference of vertical formation thickness is great due to the variation of true formation dips.

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**Number of references:** 18

**Main heading:** Horizontal wells

**Controlled terms:** Geological surveys - Global optimization - Petroleum

prospecting - Stratigraphy - Tunneling (excavation)

**Uncontrolled terms:** Conventional methods - Gas exploration - High quality reservoir - Horizontal section - Matching degree - Three dimensional space - Torsional orientation - Two-stage methods

**Classification code:** 401.2 Tunnels and Tunneling - 481.1 Geology - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 921.5 Optimization Techniques

**DOI:** 10.3787/j.issn.1000-0976.2020.06.006

**Database:** Compendex

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34.

**Accession number:** 20200908220950

**Title:** **Applicable conditions of the binomial pressure method and pressure-squared method for gas well deliverability evaluation**

**Title of translation:** 气井产能评价二项式压力法, 压力平方方法的适用条件

**Authors:** Sun, Hedong ; Meng, Guangren ; Cao, Wen ; Su, Xiaobin ; Liang, Zhidong ; Zhang, Runjie ; Zhu, Songbai ; Wang, Shengjun

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration & Development, Langfang; Hebei; 065007, China  
PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Issue date:** January 25, 2020

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**Pages:** 69-75

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**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to quickly and accurately evaluate gas well deliverability, it is necessary to clarify the applicable conditions of the simplified laminar-inertial-turbulent gas well deliverability evaluation method (i.e., pressure-squared method and pressure method). In

this regard, this paper analyzes the PVT data, simulation wells and field case wells of typical gas reservoirs in China by reviewing the formal evolution of the flow control equation for the real gases in porous media. Then, the applicable conditions of binomial pressure-squared method and pressure method are discussed. And the following research results were obtained. First, when the pressure is lower than 14 MPa,  $\mu Z$  is basically a constant; and when the pressure is higher than 42 MPa, is basically a constant. Second, the applicable range of the pressure-squared method can be increased from 14 to 20 MPa. In this case, the relative error of absolute open flow potential calculated using the pressure-squared method is less than 5% compared with the pseudo-pressure method. If the pressure is between 20 and 30 MPa, the relative error of the absolute open flow potential calculated using the pressure-squared method is less than 10%. Third, when the pressure exceeds 80 MPa, the relative error of the absolute open flow potential calculated using the pressure method is less than 10% compared with the pseudo-pressure method. If the pressure-squared method is used in the case of high pressure, the calculated absolute open flow potential is lower and the relative error is close to 25%. Fourth, in the case of low pressure, if the pressure is constant, the higher the temperature is, the smaller the relative error between the pressure-squared method and the pseudo-pressure method is. In the case of high pressure, if the pressure is constant, the higher the temperature is, the greater the relative error between the pressure method and the pseudo-pressure method. In conclusion, it is recommended to adopt the pseudo-pressure method in laminar-inertial-turbulent gas well deliverability analysis. In the case of low pressure (below 30 MPa), the pressure-squared method can be used. In the case of high pressure (above 80 MPa), the pressure method can be applied.

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**Number of references:** 18

**Main heading:** Petroleum reservoir evaluation

**Controlled terms:** Errors - Gases - Natural gas wells - Petroleum reservoirs - Porous materials

**Uncontrolled terms:** Applicable conditions - Deliverability - Gas well - High pressure - Low pressures - Pressure methods - Pseudo pressure

**Classification code:** 512 Petroleum and Related Deposits - 951 Materials Science

**Numerical data indexing:** Percentage 1.00e+01%, Percentage 2.50e+01%, Percentage 5.00e+00%, Pressure 1.40e+07Pa, Pressure 1.40e+07Pa to 2.00e+07Pa, Pressure 2.00e+07Pa to 3.00e+07Pa, Pressure 3.00e+07Pa, Pressure 4.20e+07Pa, Pressure 8.00e+07Pa

**DOI:** 10.3787/j.issn.1000-0976.2020.01.009

**Database:** Compendex

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35.

**Accession number:** 20200908220998

**Title:** Feasibility of extended drilling of aluminum alloy drill pipes in long horizontal wells

**Title of translation:** 铝合金钻杆在长水平井段延伸钻进的可行性

**Authors:** Zhu, Xiaohua ; Li, Ke

**Author affiliation:** College of Electromechanic Engineering, Southwest Petroleum University, Chengdu; Sichuan; 610500, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 1

**Issue date:** January 25, 2020

**Publication year:** 2020

**Pages:** 88-96

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** At present, the key research on shale gas well drilling in China targets the long horizontal wells with vertical depth over 4 000 m. Long horizontal drill string requires the drill pipe to transmit greater axial force to resist the friction along the string. And the adoption of light aluminum alloy drill pipe is a revolutionary technology of extended drilling with greater implementation feasibility, but its friction torque characteristics, weight on bit (WOB) transfer laws, buckling characteristics, safety & reliability and other problems have not been studied systematically. In this regard, a dynamic model of multi-dimension aluminum alloy drill string according to the principle of Hamilton was established. Then, the model was solved using the HHT- $\alpha$  method. Finally, the contact friction, WOB transfer laws and influencing factors of aluminum alloy drilling tools were compared with those of steel drilling tools. And the following research results were obtained. First, the pressure loss of the aluminum alloy drill pipe is obviously lower than that of steel drill pipe. Second, aluminum

alloy is softer, so small-sized aluminum alloy drill pipe is prone to buckling in the process of drilling, which leads to the reduction of WOB transfer efficiency and even the occurrence of "self-locking drill pipe" phenomenon. Third, the large-sized aluminum alloy drill pipe is smaller in buckling deformation and it is superior to the small-sized aluminum alloy drill pipe in terms of friction drag reduction effect. The friction drag of the OD 147 mm aluminum alloy drill pipe is only 71.9% that of the OD 129 mm aluminum alloy drill pipe. In conclusion, the rigidity of small-sized aluminum alloy drill pipes cannot satisfy the strict drilling conditions of shale gas wells with long horizontal sections, and large-sized aluminum alloy drill pipes are one of the important prerequisites for solving the difficulty of extended drilling.

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**Number of references:** 25

**Main heading:** Aluminum alloys

**Controlled terms:** Aluminum coated steel - Buckling - Drag - Drill pipe - Drill strings - Drills - Dynamics - Friction - Horizontal drilling - Horizontal wells - Infill drilling - Natural gas wells - Shale gas - Well drilling

**Uncontrolled terms:** Buckling deformation - Friction drag - Friction drag reductions - Long horizontal wells - Pressure loss - Revolutionary technology - Transfer efficiency - WOB transfer

**Classification code:** 511.1 Oil Field Production Operations - 511.2 Oil Field Equipment - 512.1.1 Oil Fields - 512.2.1 Natural Gas Fields - 522 Gas Fuels - 541.1 Aluminum - 541.2 Aluminum Alloys - 603.2 Machine Tool Accessories

**Numerical data indexing:** Percentage 7.19e+01%, Size 1.29e-01m, Size 1.47e-01m, Size 4.00e+03m

**DOI:** 10.3787/j.issn.1000-0976.2020.01.012

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

36.

**Accession number:** 20201208317944

**Title:** Tectonic-lithofacies paleogeographic characteristics of Cambrian-Ordovician deep marine carbonate rocks in the Ordos Basin

**Title of translation:** 鄂尔多斯盆地寒武系-奥陶系深层海相碳酸盐岩构造-岩相古地理特征

**Authors:** Zhou, Jingao ; Xi, Shengli ; Deng, Hongying ; Yu, Zhou ; Liu, Xinshe ; Ding, Zhenchun ; Li, Weiling ; Tang, Jin

**Author affiliation:** PetroChina Hangzhou Research Institute of Geology, Hangzhou;

Zhejiang; 310023, China

CNPC Key Laboratory of Carbonate Reservoir, Hangzhou;  
Zhejiang; 310023, China

PetroChina Changqing Oilfield Company, Xi'an; Shaanxi; 710018,  
China

China University of Petroleum, Beijing, Beijing; 102249, China

**Source title:** Natural Gas Industry

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**Volume:** 40

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**Issue date:** February 25, 2020

**Publication year:** 2020

**Pages:** 41-53

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** For many years, research achievements on the tectonic-lithofacies paleogeography of marine carbonate rock have been playing an important role in the deployment of oil and gas exploration in the Ordos Basin. Due to limited data and cognitions, however, the existing sedimentary facies maps cannot meet the demand of exploration and development of deep marine carbonate oil and gas reservoirs in the Ordos Basin. After investigating the palaeogeomorphological setting of the Ordos Basin, this paper analyzed the paleogeographic characteristics of Middle Cambrian Zhangxia Formation and Lower Ordovician Majiagou Formation by plotting its tectonic-lithofacies paleogeography map, based on new well drilling and seismic data, combined with lithofacies identification techniques. Then, the sedimentary models of two periods were established and the controlling effect of paleogeography on reservoir development and distribution was researched. And the following research results were obtained. First, during the deposition of Zhangxia Formation, the paleogeographic setting was in the pattern of "three uplifts and four depressions", which extended in the northeast direction under the effect of the Pre-Sinian rift. The depressions evolved into deep-water bays or intra-platform lows, the uplifts evolved into carbonate platforms, and the oolitic shoals developed around uplift-depression transition zones and paleo-uplifts. And they constitute the favorable reservoir facies belt in the Zhangxia Formation. Second, the paleogeographic pattern during the deposition of the Majiagou Formation was "three uplifts, two sags

and one salient", and it mainly extended along north and south. Paleo-uplifts acted as important barriers. In the transgression stage, shoals and flats developed around the paleo-uplifts and depressions evolved into lagoons. In the regression stage, paleo-uplifts got exposed and depressions evolved into gypsum salt lakes. Gypsum and dolomite flat became a favorable reservoir facies zone and lagoon became an important place for cap rock development. Third, tectonic-lithofacies paleogeography controls reservoirs sedimentary setting and material bases and has important influence on the reconstruction scope and the degree of early dolomitization and karstification, so as to control the macro-distribution of favorable reservoirs. Fourth, the sedimentary models of the rimmed platform in the Zhangxia Formation and the barrier platform in the Majiagou Formation reveal that there are three potential plays in the Zhangxia Formation and two plays in the Majiagou Formation. In conclusion, the weathered crust in the Zhangxia Formation, the weathered crust in the upper plays of Majiagou Formation and the grain beach in the middle-lower plays of Majiagou Formation are the favorable oil and gas exploration directions in the Ordos Basin.

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**Number of references:** 56

**Main heading:** Petroleum prospecting

**Controlled terms:** Carbonates - Carbonation - Deposition - Geological surveys - Gypsum - Metamorphic rocks - Offshore gas fields - Petroleum reservoir engineering - Petroleum reservoirs - Sedimentary rocks - Sedimentology - Seismology - Tectonics - Well drilling

**Uncontrolled terms:** Cambrians - Deep-marine - Lithofacies - Oil and gas exploration - Ordos Basin - Ordovician - Reservoir distribution - Sedimentary models

**Classification code:** 481.1 Geology - 482.2 Minerals - 484.1 Earthquake Measurements and Analysis - 512 Petroleum and Related Deposits - 802.2 Chemical Reactions - 802.3 Chemical Operations - 804.2 Inorganic Compounds

**DOI:** 10.3787/j.issn.1000-0976.2020.02.005

**Database:** Compendex

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37.

**Accession number:** 20201208317998

**Title:** **Enrichment laws of deep tight sandstone gas reservoirs in the Western Sichuan Depression, Sichuan Basin**

**Title of translation:** 四川盆地川西坳陷深层致密砂岩气藏富集规律

**Authors:** Liu, Zhongqun ; Xu, Shilin ; Liu, Junlong ; Ma, Liyuan ; Liu, Sibing ; Fan, Xin ; Jin, Wujun ; Li, Wangpeng

**Author affiliation:** Sinopec Exploration & Production Research Institute, Beijing; 100083, China  
Chengdu University of Technology, Chengdu; Sichuan; 610059, China

**Corresponding author:** Xu, Shilin (xushilin.syky@sinopec.com)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 2

**Issue date:** February 25, 2020

**Publication year:** 2020

**Pages:** 31-40

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The deep tight sandstone gas reservoir of Xujiahe Formation of Upper Triassic in the Sichuan Basin is faced with such problems as low ratio of effective wells, low reserve production rate and difficult effective scale development. In order to find out its accumulation process and enrichment laws and confirm the main control factors of high production, this paper carried out a series of studies by taking the gas reservoir of the second Member of Xujiahe Formation (hereinafter referred to as Xu-2 Member) in the Xinchang structural belt of the Sichuan Basin as the research object. Firstly, the time sequence of key hydrocarbon accumulation factors was determined by means of homogenization temperature of fluid inclusion, single-well burial and thermal history reconstruction, paleo-structure restoration and porosity evolution history analysis. And combined with structural evolution analysis, the hydrocarbon accumulation model of Xu-2 Member gas reservoir was established and the enrichment laws of natural gas in this area were analyzed. Then, based on the statistical analysis on the relationship between single-well productivity and the geological parameters (such as fault, fracture and lithofacies), the main factors controlling the high and stable production of gas wells were determined. Finally,

measures for exploring and developing this type of deep tight sandstone gas reservoir efficiently were put forward. And the research results were obtained. First, the main hydrocarbon accumulation period of the Xu-2 Member gas reservoir in the Xinchang structural belt is earlier than the key period of its reservoir densification and later than the key formation period of its trap. Second, the Xu-2 Member gas reservoir presents a hydrocarbon accumulation model in the sequence of "hydrocarbon accumulation-reservoir densification-later gas reservoir adjustment" and the enrichment laws of "style setting in the early stage, densification in the middle stage and production controlling in the late stage". Third, the gas production rates of gas wells are mainly controlled by the development degree of structural fractures in the initial stage and by the thickness of favorable lithofacies in the stable production stage. The development degree of high-angle structural fractures is the key factor to control the high production of gas reservoirs. In conclusion, the zones where the structures are always uplifts and those with developed N-S striking faults are the preferred targets of Xinchang structural belt for high gas production. Natural gas in type III reservoirs with under-developed or undeveloped N-S striking structural faults cannot be developed effectively unless single-well productivity is increased by means of reservoir stimulation.

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**Number of references:** 27

**Main heading:** Natural gas wells

**Controlled terms:** Densification - Factor analysis - Fracture - Gases - Hydrocarbons - Natural gas - Natural gas well production - Oil field development - Petroleum reservoirs - Productivity - Proven reserves - Sandstone - Structural analysis - Tight gas - Well stimulation

**Uncontrolled terms:** Effective development - Enrichment law - Hydrocarbon accumulation - Sichuan Basin - Tight sandstone gas - Upper Triassic - Western Sichuan

**Classification code:** 408.1 Structural Design, General - 482.2 Minerals - 512 Petroleum and Related Deposits - 522 Gas Fuels - 802.3 Chemical Operations - 804.1 Organic Compounds - 922.2 Mathematical Statistics - 951 Materials Science

**DOI:** 10.3787/j.issn.1000-0976.2020.02.004

**Database:** Compendex

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38.

**Accession number:** 20202308799551

**Title:** An internal structure anatomy method for braided-river sandstone reservoirs and its application in the Sulige Gas Field of the Ordos Basin

**Title of translation:** 辫状河砂岩储层内部结构解剖方法及其应用-以鄂尔多斯盆地苏里格气田为例

**Authors:** Li, Zhuzheng ; Li, Kaijian ; Li, Bo ; Wang, Jiahui ; Zhong, Jinyin ; Wang, Haifeng ; Yao, Wujun

**Author affiliation:** Geological Exploration & Development Research Institute, CNPC Chuanqing Drilling Engineering Co., Ltd., Chengdu; Sichuan; 610051, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Issue date:** April 25, 2020

**Publication year:** 2020

**Pages:** 30-39

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The lower submember of the 8th Member of Middle Permian Shihezi Formation in the northern Sulige Gas Field of the Ordos Basin (hereinafter, "He 8 lower submember" for short) is classified as braided river deposit in the delta plain subfacies of braided river. This gas reservoir is a rare tight sandstone reservoir of low permeability, low formation pressure and low abundance, with complex distribution rules of effective sand bodies and low drilling rate of effective reservoirs in horizontal wells. In order to figure out the distribution rules of effective sand bodies, this paper precisely characterized the internal structures of thick sandstone in terms of single braided channel, composite diara, single diara and diara internal structure, based on modern sedimentation and outcrop, with the focus on the infill well blocks and the composite diara as the main research object. Then, multi-level quantitative recognition and internal structure anatomy method was established, and the internal structures of the thick sandstone in this area were described elaborately. Finally, the gas bearing property was analyzed. And the following research results were obtained. First, the single braided channel of He 8 lower submember in this area is 600-3 500 m wide, the composite diara is 1 500-2 500 m long and 800-1 400 m wide, and the single diara

is 1 000-1 750 m long and 300-1 050 m wide. Three or four accretion sand bodies are generally developed in a diara. Second, the effective sand bodies of He 8 lower submember are mainly controlled by the distribution of diaras. They are vertically in a "lenticular" distribution pattern due to the barrier of bedding interbeds, and areally in an "isolated island" distribution pattern. Third, gas bearing property is good in the water face of the diara, moderate in the central position and poor in the back surface. In conclusion, this proposed multi-level internal structure anatomy method for braided-river thick sandstone reservoir can establish the enrichment model of effective sand body and provide fine geological basis for the optimal design of horizontal wells and the technical support for the efficient development of horizontal wells in the Sulige Gas Field.

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**Number of references:** 21

**Main heading:** Low permeability reservoirs

**Controlled terms:** Gas bearings - Gases - Helium - Horizontal wells - Infill drilling - Metamorphic rocks - Petroleum reservoir engineering - Rivers - Sand - Sandstone

**Uncontrolled terms:** Bearing properties - Distribution patterns - Effective reservoir - Enrichment models - Internal structure - Low formation pressure - Sandstone reservoirs - Tight sandstone reservoirs

**Classification code:** 482.2 Minerals - 483.1 Soils and Soil Mechanics - 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 601.2 Machine Components - 804 Chemical Products Generally

**Numerical data indexing:** Size 1.00e+03m to 1.75e+03m, Size 1.50e+03m to 2.50e+03m, Size 3.00e+02m to 1.05e+03m, Size 6.00e+02m to 3.50e+03m, Size 8.00e+02m to 1.40e+03m

**DOI:** 10.3787/j.issn.1000-0976.2020.04.004

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39.

**Accession number:** 20200908220980

**Title:** Working performance of a nylon-cord packer rubber cylinder and its influencing factors

**Title of translation:** 锦纶帘线封隔器胶筒工作性能及其影响因素

**Authors:** Wang, Hanxiang ; Zhang, Yanwen ; Che, Jiaqi ; Liu, Yanxin ; Lan, Wenjian ; Du, Mingchao

**Author affiliation:** College of Electromechanical Engineering, China University of Petroleum <East China>, Dongying; Shandong; 257061, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Issue date:** January 25, 2020

**Publication year:** 2020

**Pages:** 97-103

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Although a nylon-cord packer rubber cylinder is suitable for open-hole well conditions with small wellbore, irregular wall and high formation pressure, it is disadvantageous with low pressure bearing capacity and poor sealing performance. In order to improve the working performance of a nylon-cord rubber cylinder, it is necessary to clarify the material parameters of the rubber cylinder and cord on the basis of tensile test and Gough-Tangorra theory. A three-dimensional numerical simulation model for a nylon-cord rubber cylinder was established, and its accuracy was verified based on laboratory tests. Besides, the change laws of the stress and contact stress of nylon-cord rubber cylinder under different setting pressures were studied, and the effects of cord angle, cord layer amount and cord spacing on the pressure bearing capacity and sealing performance of the packer rubber cylinder were analyzed systematically. And the following research results were obtained. First, the maximum setting pressure, maximum working pressure and residual deformation of nylon-cord rubber cylinder measured in the tests are 70 MPa, 50 MPa and 3.2%, respectively. Second, the three-dimensional numerical simulation model for nylon-cord rubber cylinder is established based on REFINE 265 unit, and the error between the simulation result and the test result is about 15%, which can satisfy the needs of engineering analysis. Third, with the increase of the cord angle from 14° to 20°, the cord stress increases linearly and the rubber stress and contact stress decrease slightly. Fourth, as the number of cord layers increases from 2 to 8, the rubber stress and contact stress decrease significantly, and the decrease rate of the cord stress increases with the highest decrease amplitude up to 64%. Fifth, with the increase of cord spacing from 1.4 mm to 2 mm, the rubber stress and cord stress increase synchronously and the contact stress decreases. In conclusion, the research results provide a theoretical basis for improving the working

performance of nylon-cord rubber cylinder.

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**Number of references:** 21

**Main heading:** Rubber

**Controlled terms:** Bearing capacity - Bearings (machine parts) - Computer simulation - Cylinders (shapes) - Numerical models - Packers - Polyamides - Rayon - Tensile testing

**Uncontrolled terms:** Contact Stress - Engineering analysis - Laboratory test - Pressure bearing capacity - Residual deformation - Rubber stress - Three-dimensional numerical simulations - Working performance

**Classification code:** 511.2 Oil Field Equipment - 601.2 Machine Components - 723.5 Computer Applications - 815.1.1 Organic Polymers - 818.1 Natural Rubber - 819.2 Synthetic Fibers - 921 Mathematics

**Numerical data indexing:** Percentage 1.50e+01%, Percentage 3.20e+00%, Percentage 6.40e+01%, Pressure 5.00e+07Pa, Pressure 7.00e+07Pa, Size 1.40e-06m<sup>2</sup> to 2.00e-03m<sup>2</sup>

**DOI:** 10.3787/j.issn.1000-0976.2020.01.013

**Database:** Compendex

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40.

**Accession number:** 20201708556795

**Title:** Sedimentary facies and oil and gas exploration prospect of the Upper Triassic Baiguowan Formation in the Xichang Basin

**Title of translation:** 西昌盆地上三叠统白果湾组沉积相与油气勘探前景

**Authors:** Yang, Wei ; Wei, Guoqi ; Jin, Hui ; Hao, Cuiguo ; Shen, Yuhong ; Wang, Xiaodan

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration and Development, Beijing; 100083, China

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**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 13-22

**Language:** Chinese

**ISSN:** 10000976**CODEN:** TIGOE3**Document type:** Journal article (JA)**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The Xichang Basin is a potential area for oil and gas exploration in China, but the sedimentation of the Upper Triassic Baiguowan Formation in this basin is less understood and no significant breakthrough has been made in its oil and gas exploration. In order to speed up the oil and gas exploration of the Baiguowan Formation in the Xichang Basin, this paper systematically studied the types and characteristics of sedimentary facies, the sedimentary systems and the distribution of sand bodies of the Baiguowan Formation in the Xichang Basin based on the outcrop, drilling and analysis assay data of Upper Triassic in the Xichang Basin and the Sichuan basin. Then, its relationship with the Xujiahe Formation of Upper Triassic in the Sichuan Basin was discussed, and its oil and gas exploration prospect was evaluated. And the following research results were obtained. First, the Baiguowan Formation in the Xichang Basin is mainly composed of sandstone and mudstone, which can be divided into four lithologic sections, corresponding to the third to sixth members of Xujiahe Formation in the Sichuan Basin, and sandstone is developed in the second Member of Baiguowan Formation. Second, there are mainly three types of sedimentary systems in the Baiguowan Formation, including fan delta, river delta and lake. In the basin, lakes and river deltas are dominant and delta front sand bodies and bar sand bodies are developed. Third, during the sedimentation of Baiguowan Formation, the Xichang Basin and the Sichuan Basin were a whole with the same sedimentary system and the basically accordant structural evolution, and the water body mainly flowed from the Sichuan Basin to the Xichang Basin. Fourth, the argillaceous source rocks of Baiguowan Formation are thick with good hydrocarbon generation potential. The sand bodies of delta front and the bar sand bodies in lakes have certain reservoir capacity. It is concluded that the Baiguowan Formation in the Xichang Basin has a good prospect of natural gas exploration because of its source-reservoir integration, large area superimposition and good source-reservoir allocation.

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**Number of references:** 21

**Main heading:** Petroleum prospecting

**Controlled terms:** Distributed database systems - Gases - Geological surveys - Lakes - Sand - Sandstone - Sedimentology

**Uncontrolled terms:** Hydrocarbon generation potential - Natural gas exploration - Oil and gas exploration - Reservoir capacity - Sedimentary

facies - Sedimentary systems - Structural evolution - Xujiache formation

**Classification code:** 481.1 Geology - 482.2 Minerals - 483.1 Soils and Soil Mechanics - 512.1.2 Petroleum Deposits : Development Operations - 723.3 Database Systems

**DOI:** 10.3787/j.issn.1000-0976.2020.03.002

**Database:** Compendex

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41.

**Accession number:** 20202308799566

**Title:** A logical growth model considering the influence of shale gas reservoirs and development characteristics

**Title of translation:** 考虑页岩气储层及开发特征影响的逻辑增长模型

**Authors:** Zhao, Qun ; Wang, Hongyan ; Sun, Qinqing ; Jiang, Xinchun ; Yu, Rongze ; Kang, Lixia ; Wang, Xuefan

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration & Development, Beijing; 100083, China  
National Energy Shale Gas R & D <Experimental> Center, Langfang; Hebei; 065007, China

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**Volume:** 40

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**Publication year:** 2020

**Pages:** 77-84

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** As shale gas development is advancing continuously and rapidly, how to deeply analyze the production performance of shale gas wells and evaluate their production characteristics has become an urgent problem in the evaluation of shale gas productivity construction zone, the formulation of new area development scheme and the preparation of planning program. Some scholars have applied the logical growth model (LGM model) in the

production decline analysis of unconventional gas wells, but the influences of shale gas reservoir and development characteristics are not taken into consideration. Therefore, this method still has some space of further development and improvement. In this paper, a logistic growth model considering shale gas reservoirs and development characteristics (RB-LGM model) was established based on the previous research results. Then, it was applied to the shale gas development wells in the Changning Block of the Sichuan Basin to analyze their production performance, and the analysis results were compared with the fitting and prediction results provided by Arps hyperbolic decline model. Finally, the optimal well spacing of horizontal wells was determined using the RB-LGM model. And the following research results were obtained. First, shale gas is produced by deploying horizontal wells in the clustered pattern in a large number, so on the basis of the LGM model, RB-LGM model takes shale gas reservoir parameters (thickness, shale density, gas content) and development parameters (horizontal section length, well spacing and recovery factor) as the logic control factors of horizontal- well gas production fitting, so that the production prediction result of gas well is more reasonable. Second, the RB-LGM model can not only well fit the early production data of gas well, but ensure the convergence of the later prediction results under the control of logical conditions. Third, the RB-LGM model takes into account the influence of shale gas reservoir and development characteristics so as to optimize the horizontal well pattern and analyze the change trend of reservoir parameters in the development area through data inversion.

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**Number of references:** 28

**Main heading:** Well spacing

**Controlled terms:** Density of gases - Forecasting - Gas industry - Gases - Horizontal wells - Natural gas well production - Natural gas wells - Petroleum reservoir evaluation - Petroleum reservoirs - Shale gas

**Uncontrolled terms:** Development characteristics - Logistic growth model - Production characteristics - Production decline analysis - Production performance - Production prediction - Reservoir parameters - Shale gas reservoirs

**Classification code:** 512 Petroleum and Related Deposits - 522 Gas Fuels - 931.2 Physical Properties of Gases, Liquids and Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.04.009

**Database:** Compendex

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**Accession number:** 20200908220938

**Title:** Structural reworking effects and new exploration discoveries of subsalt ultra-deep reservoirs in the Kelasu tectonic zone

**Title of translation:** 克拉苏构造带盐下超深层储层的构造改造作用与油气勘探新发现

**Authors:** Wei, Guoqi ; Wang, Junpeng ; Zeng, Lianbo ; Tang, Yongliang ; Wang, Ke ; Liu, Tiantian ; Yang, Yu

**Author affiliation:** Tarim Basin Research Center, PetroChina Research Institute of Petroleum Exploration and Development, Beijing; 100083, China  
College of Geosciences, China University of Petroleum, Beijing; 102249, China  
PetroChina Hangzhou Institute of Geology, Hangzhou; Zhejiang; 310023, China  
PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China  
No.1 Mud Logging Company, CNPC Bohai Drilling Engineering Co., Ltd., Tianjin; 300280, China

**Corresponding author:** Wang, Junpeng (wangjp\_hz@petrochina.com.cn)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

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**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The Bashijiqike Formation of Lower Cretaceous in the oil and gas group in the Kelasu tectonic zone of the Tarim Basin is deeper than 6 000 m with the characteristics of low reservoir matrix permeability, developed fractures and significant reworking effect of structure on reservoir. However, the exploration breakthrough of Well Bozi 9 reflects that the structural reworking effects in different zones vary greatly and the heterogeneity is quite strong. Therefore, recognizing the structural reworking effects on reservoirs again is of great significance in predicting ultra-deep reservoirs and guiding oil & gas exploration and production. In

this paper, the structural reworking effects on the ultra-deep reservoirs in the oil and gas group of Kelasu tectonic zone and their diversity were qualitatively analyzed and quantitatively calculated using drilling coring, structural equilibrium and restoration, isotopic dating of fracture fillings and numerical simulation of block stress, combined with fluid inclusion analysis, acoustic emission paleo-stress analysis, casting slice and other experimental analysis methods. And the following research results were obtained. First, the Tianshan orogenic belt in the north and the paleo-uplift in the south dominate the sedimentary pattern and the differential tectonic deformation of reservoirs in this tectonic zone. As a result, the distribution characteristics of being "thin in the west and thick in the east" of the Bashijiqike Formation reservoir are formed. Second, in the Bozi Block, paleo-stress is the smallest, structural deformation is mainly in the form of forward compression and thrust propagation, and oblique compression and torsion occurs in local well blocks. Third, in the Dabei Block, oblique compression and torsion is dominant, paleo-stress is smaller and structural deformation is in the form of thrust stacking. And in the Keshen Block, paleo-stress is the highest and structural deformation is mainly in the form of forward compression, thrust and uplift of trailing edge, and slippage and shrinkage of leading edge. Fourth, differential tectonic deformation results in a large difference in the amount of structural reduction in the same structural belt with different structural deformation patterns. And it also controls the superimposed effects of fracture formation and diagenetic cementation in different blocks and the configuration relationship between fracture networks and oil & gas accumulation periods in the middle and late stages, and increases the reservoir heterogeneity. Therefore, the differential structural deformation is the basic reworking factor for the variation of productivity in different blocks. Fifth, the magnitude and direction of the current tectonic stress affect the fracture effectiveness. In the southern part, the compressive stress is strong, the intersection angle between the fracture direction of the higher position of the anticline and the current stress is smaller, and the fracture effectiveness is the best. Sixth, the type of structural fracture fillings is dependent on the structural diagenetic environment. In the northern block, the diagenetic environment of freshwater and semi-alkaline medium is dominant, so the type of fracture fillings is calcite, which is conducive to the acid fracturing of reservoir.

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**Number of references:** 31

**Main heading:** Acoustic emission testing

**Controlled terms:** Calcite - Compressive stress - Deformation - Filling - Fracture - Low permeability reservoirs - Numerical methods - Petroleum prospecting - Petroleum reservoir engineering -

Shrinkage - Stress analysis - Structural analysis - Subsalt strata - Tectonics - Torsional stress

**Uncontrolled terms:** Diversity - Early Cretaceous - Paleogeomorphology - Sub salts - Tarim Basin - Tectonic deformations - Ultra deeps

**Classification code:** 408.1 Structural Design, General - 481.1 Geology - 482.2 Minerals - 512.1 Petroleum Deposits - 512.1.2 Petroleum Deposits : Development Operations - 691.2 Materials Handling Methods - 751.2 Acoustic Properties of Materials - 921.6 Numerical Methods - 951 Materials Science

**Numerical data indexing:** Size 6.00e+03m

**DOI:** 10.3787/j.issn.1000-0976.2020.01.003

**Database:** Compendex

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43.

**Accession number:** 20201708556738

**Title:** Hydrocarbon accumulation conditions of the buried hills in the central paleo-uplift belt of the northern Songliao Basin

**Title of translation:** 松辽盆地北部中央古隆起带古潜山天然气成藏条件

**Authors:** Sun, Lidong ; Sun, Guoqing ; Yang, Buzeng ; Zhao, Fuhai ; Li, Jing ; Li, Guangwei ; Xu, Yan

**Author affiliation:** Exploration and Development Research Institute, PetroChina Daqing Oilfield Company, Daqing; Heilongjiang; 163712, China  
Exploration Department, PetroChina Daqing Oilfield Company, Daqing; Heilongjiang; 163712, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 23-29

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The central paleo-uplift belt is an important deep-seated oil and gas exploration area of the Songliao Basin, but its oil and gas exploration process is restricted due to its complex gas accumulation conditions and for lack of the understanding of its reservoir distribution and hydrocarbon accumulation laws. In order to provide technical support for the efficient oil and gas exploration in this central paleo-uplift belt, this paper carried out systematical studies in terms of gas source conditions, reservoir conditions and hydrocarbon accumulation models by using the drilling, 3D seismic and test data comprehensively. Then, the understandings obtained in the oil and gas exploration practice were summarized and the hydrocarbon accumulation models of the natural gas in this area were confirmed. And the following research results were obtained. First, this paleo-uplift belt is adjacent to the hydrocarbon generation center of Xujiaweizi fault depression and the source rocks of Lower Cretaceous Shahezi Formation have high hydrocarbon generation intensity, wide hydrocarbon supply window, and sufficient gas source. Second, under the effect of early intense extrusion and late tensile extension, a large-scale structure is developed in this paleo-uplift belt, and it has a good structural background and provides good trap conditions for natural gas migration and accumulation. Third, this central paleo-uplift belt suffered long-term exposure and erosion, and a weathering crust of large-area distribution is formed with good reservoir properties. Fourth, the upper part of this central paleo-uplift belt is overlain by the mudstone of the second Member of Denglouku Formation of Lower Cretaceous, which acts as the regional caprock. In conclusion, this central paleo-uplift belt is in the internal hydrocarbon accumulation model of large-area weathering crust under the structural control. By adopting the technology of "horizontal well + large-scale stimulated reservoir volume (SRV)", it is expected to realize a breakthrough in gas productivity of large-area tight gas reservoir in this area.

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**Number of references:** 20

**Main heading:** Petroleum prospecting

**Controlled terms:** Gases - Geological surveys - Horizontal wells - Hydrocarbons - Natural gas - Petroleum reservoirs - Structural dynamics - Tensile strength - Tight gas - Weathering

**Uncontrolled terms:** Hydrocarbon accumulation - Hydrocarbon generation - Large scale structures - Natural gas migration and accumulations - Oil and gas exploration - Reservoir distribution - Stimulated reservoir volumes - Xujiaweizi Fault Depression

**Classification code:** 408 Structural Design - 481.1 Geology - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 804.1 Organic Compounds

**DOI:** 10.3787/j.issn.1000-0976.2020.03.003

**Database:** Compendex

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44.

**Accession number:** 20201708556740

**Title:** Application of the combination of high-pressure mercury injection and nuclear magnetic resonance to the classification and evaluation of tight sandstone reservoirs: A case study of the Linxing Block in the Ordos Basin

**Title of translation:** 联合高压压汞和核磁共振分类评价致密砂岩储层--以鄂尔多斯盆地临兴区块为例

**Authors:** Kong, Xingxing ; Xiao, Dianshi ; Jiang, Shu ; Lu, Shuangfang ; Sun, Bin ; Wang, Jingming

**Author affiliation:** School of Geosciences and Technology, China University of Petroleum - East China, Qingdao; Shandong; 266580, China  
Key Laboratory of Tectonic and Hydrocarbon Resource, Ministry of Education, China University of Geosciences - Wuhan, Wuhan; Hubei; 430074, China

**Corresponding author:** Xiao, Dianshi (xiaods@upc.edu.cn)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 3

**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 38-47

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Tight sandstone gas reservoirs have poorer porosity-permeability relationships, so conventional reservoir classification schemes can hardly satisfy the classification and evaluation demand of this type of reservoirs. To solve this problem, this paper took the Permian tight sandstone gas reservoir in the Linxing Block along the eastern margin of the Ordos Basin as an example to describe the micro-structures of the tight sandstone reservoirs by means

of high-pressure mercury injection, nuclear magnetic resonance (NMR), scanning electron microscope (SEM) and so on. Then, the control effect of micro-structure parameters on the macrophysical properties was studied. Finally, classification and evaluation of tight sandstone reservoirs were carried out on this basis. And the following research results were obtained. First, NMR can identify the distribution of pores of different sizes, and high-pressure mercury injection can reflect the pore-throat configuration and percolation capacity of a reservoir. Second, both methods are better coincident in the description results. With an increase of the right peak of T2 spectra, the mercury intrusion curve presents a concave shape and the pore throat radius increases while the pore type gradually changes from intragranular dissolution pores and intercrystalline pores to intergranular pores and intergranular dissolution pores and the reservoir quality gets better. Third, micro-pore structure controls reservoir physical properties and fluid mobility. And the porosity of large pores is best correlated with the effective porosity, so it can be used to evaluate the reservoir capacity of tight sandstone. Fourth, the throat radius R15 obtained by high pressure mercury injection is in the best correlation with porosity and permeability, so it can be used to evaluate the percolation capacity of tight sandstone. Fifth, by combining the porosity of large pores with the R15, the tight sandstone reservoirs in the Linxing Block are classified into 4 categories, and the classification results are in a good agreement with the on-site well test data. It is concluded that the combination of high-pressure mercury injection and NMR can effectively identify the key parameters which reflect the reservoir capacity and percolation capacity of tight sandstone, and improve the reliability and integrity of reservoir classification. And by selecting the key parameters that reflect reservoir capacity and percolation capacity, it can provide the guidance for the classification and evaluation of tight sandstone reservoirs.

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**Number of references:** 38

**Main heading:** Petroleum reservoir evaluation

**Controlled terms:** Dissolution - Metamorphic rocks - Nuclear magnetic resonance - Petroleum reservoirs - Pore structure - Porosity - Sandstone - Scanning electron microscopy - Solvents - Textures - Tight gas - Well testing

**Uncontrolled terms:** Classification and evaluations - Classification results - Intercrystalline pores - Micro-structure parameters - Nuclear magnetic resonance(NMR) - Pore-throat configurations - Reservoir physical property - Tight sandstone reservoirs

**Classification code:** 482.2 Minerals - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 802.3 Chemical Operations - 803 Chemical Agents and Basic Industrial Chemicals - 931.2 Physical Properties of Gases, Liquids and Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.03.005

**Database:** Compendex

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45.

**Accession number:** 20202308799533

**Title:** A calculation model for water breakthrough time of gas wells in gas reservoirs with edge water considering the heterogeneity between reservoirs: A case study of the Lower Triassic Feixianguan gas reservoirs in the Puguang Gas Field

**Title of translation:** 考虑储层层间非均质性的边水气藏气井见水时间计算模型-以普光气田下三叠统飞仙关组气藏为例

**Authors:** Li, Jiqiang ; Yang, Shenyao ; Qi, Zhilin ; Zhao, Guanqun ; Yin, Bingyi ; Mo, Fei

**Author affiliation:** Chongqing Municipality Key Laboratory of Complex Oil & Gas Field Exploration and Development, Chongqing University of Science and Technology, Chongqing; 401331, China

**Corresponding author:** Yang, Shenyao (yangshenyaocq@163.com)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

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**Publication year:** 2020

**Pages:** 69-76

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The existing models for calculating the water breakthrough time of gas wells in gas reservoirs with edge water ignore the effects of reservoir's interlayer heterogeneity, so their calculation results are more deviated from the actual water breakthrough time of gas wells. As a result, they cannot accurately and effectively guide the adjustment of gas well production system and the formulation of technical water control measures. In this paper, a water-flooding seepage experiment of parallel core was conducted by taking the gas reservoir with edge water of Lower Triassic Feixianguan

Formation in the Puguang Gas Field of the Sichuan Basin as an example. Then, the effects of edge water inrush caused by the interlayer heterogeneity of reservoir on water breakthrough time of gas wells was analyzed by means of reservoir numerical simulation. Based on this, the inrush coefficient was introduced to characterize the interlayer heterogeneity of reservoir, and a model for calculating the water breakthrough time of gas wells in the commingled gas reservoir with edge water considering the influence of interlayer heterogeneity was established. Finally, five wells in the gas reservoir of Feixianguan Formation in the Puguang Gas Field were selected for case calculation. And the following research results were obtained. First, the the interlayer heterogeneity of gas reservoir results in edge water burst. And the stronger the interlayer heterogeneity, the more severe the edge water coning and the sooner the water breakthrough. The water breakthrough time of gas wells depends on the water breakthrough time in the reservoir with the highest permeability. Second, a model for calculating the water breakthrough time of gas wells in the gas reservoirs with edge water considering the influence of reservoir interlayer heterogeneity is established based on the seepage theory. And the relative errors of its calculation results is in the range of -3.43-4.70%, which can satisfy the accuracy requirement of engineering errors. In conclusion, this newly established model can provide an effective method for accurately calculating the water breakthrough time of the gas well in the commingled gas reservoir with edge water. Furthermore, it is conducive to the adjustment of the production system of gas wells in the gas reservoir with edge water and the formulation of technical water control measures.

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**Number of references:** 22

**Main heading:** Hydrocarbon seepage

**Controlled terms:** Gas industry - Gases - Natural gas well production - Natural gas wells - Petroleum reservoir engineering - Petroleum reservoirs - Reservoirs (water) - Secondary recovery

**Uncontrolled terms:** Calculation models - Calculation results - Feixianguan formation - Feixianguan gas reservoirs - Production system - Puguang gas field - Reservoir numerical simulation - Water breakthrough

**Classification code:** 441.2 Reservoirs - 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 522 Gas Fuels

**Numerical data indexing:** Percentage -3.43e+00%

**DOI:** 10.3787/j.issn.1000-0976.2020.04.008

**Database:** Compendex

46.

**Accession number:** 20202908938674

**Title:** Prediction of shale gas preservation conditions by pre-stack geophysical technology: A case study of the shale gas reservoirs in the Jiaoshiba Block of the Sichuan Basin

**Title of translation:** 叠前地球物理技术预测页岩气保存条件-以四川盆地焦石坝构造页岩气藏为例

**Authors:** Zhang, Dianwei ; Sun, Wei ; Li, Shuangjian ; Hao, Yunqing ; Liu, Ling

**Author affiliation:** Sinopec Petroleum Exploration and Production Research Institute, Beijing; 100083, China

**Corresponding author:** Sun, Wei (seagleff@126.com)

**Source title:** Natural Gas Industry

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**Volume:** 40

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**Issue date:** June 25, 2020

**Publication year:** 2020

**Pages:** 42-49

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In recent years, the immense exploration potential of shale gas in the Upper Ordovician Wufeng Formation and the Lower Silurian Longmaxi Formation in the eastern Sichuan Basin has been further confirmed especially when great breakthroughs were realized in the Fuling Shale Gas Field of the Sichuan Basin. However, how to apply geophysical technologies to evaluate shale gas preservation conditions more accurately and effectively is a burning problem in shale gas exploration and development in this area. From the perspective of fracture development degree and formation pressure, this paper first applied the fracture prediction technology based on pre-stack azimuthal anisotropy to predict high-angle fractures on the basis of pre-stack seismic data. Then, the pressure prediction technology based on pre-stack P-wave impedance inversion was used to describe the spatial distribution characteristics of formation pressure. Finally,

both of them were combined to establish a new parameter for evaluating shale gas preservation conditions, i.e., preservation indicator. In this way, a set of new method that can be used to effectively predict shale gas preservation conditions was developed. This new method was used to evaluate the shale gas preservation conditions in the Wufeng-Longmaxi Fms in the Jiaoshiba Block of Fuling Shale Gas Field, and the prediction results of preservation indicator were compared with the production data of gas wells, which demonstrated that the preservation indicator agreed well with the AOF of a shale gas well, making up the previous mismatch between a low-productivity well and its AOF. In conclusion, the predicted preservation indicator is in line with the production data of gas wells, indicating that this new method is valid and reliable in evaluating shale gas preservation conditions.

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**Number of references:** 21

**Main heading:** Gas industry

**Controlled terms:** Forecasting - Fracture - Gases - Geological surveys - Natural gas well production - Natural gas wells - Petroleum prospecting - Petroleum reservoirs - Seismic waves - Seismology - Shale gas

**Uncontrolled terms:** Azimuthal anisotropy - Distribution characteristics - Exploration potential - Geophysical technologies - Pre-stack seismic data - Preservation condition - Pressure predictions - Shale gas reservoirs

**Classification code:** 481.1 Geology - 484 Seismology - 484.1 Earthquake Measurements and Analysis - 512 Petroleum and Related Deposits - 522 Gas Fuels - 951 Materials Science

**DOI:** 10.3787/j.issn.1000-0976.2020.06.004

**Database:** Compendex

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47.

**Accession number:** 20200908220991

**Title:** Characteristics, genetic mechanism and oil & gas exploration significance of high-quality sandstone reservoirs deeper than 7 000 m: A case study of the Bashijiqike Formation of Lower Cretaceous in the Kuqa Depression

**Title of translation:** 7 000 m以深优质砂岩储层的特征, 成因机制及油气勘探意义-以库车坳陷下白垩统巴什基奇克组为例

**Authors:** Zeng, Qinglu ; Mo, Tao ; Zhao, Jilong ; Tang, Yongliang ; Zhang, Ronghu ; Xia, Jiufeng ; Hu, Chunlei ; Shi, Lingling

**Author affiliation:** PetroChina Hangzhou Institute of Geology, Hangzhou; Zhejiang;

310023, China

PetroChina Research Institute of Petroleum Exploration & Development, Beijing; 100083, China

Exploration and Development Research Institute, PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China

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**Publication year:** 2020

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**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Ultra-deep clastic reservoirs generally have poor physical properties and low single-well productivity, but Well Bozi 9, which is newly drilled in the Kuqa Depression of the Tarim Basin, encounters a thick high-quality reservoir in the Bashijiqike Formation of Lower Cretaceous deeper than 7 600 m and produces a high-yield industrial gas flow. In order to reveal the characteristics and genesis of the Bashijiqike Formation reservoir and reduce the exploration risk of ultra-deep oil and gas layers, we discussed its characteristics, genetic mechanism and oil & gas exploration significance based on cores, logging and experimental analysis, combined with regional temperature-pressure conditions and burial evolution history. And the following research results were obtained. First, the rock types of ultra-deep reservoir of Bashijiqike Formation in this area are medium- and fine-grained feldspathic litharenite and lithic arkose with point-line contact between grains, and its reservoir space is dominated by primary intergranular pores. At present, it is still at its middle diagenetic stage. Second, different from other ultra-deep fractured low-porosity sandstone reservoirs, this set of ultra-deep reservoir is a pore-type reservoir with a porosity of 4-13%, the permeability of 0.1-50.0 mD and good porosity and permeability correlation. Third, during the sedimentation of Bashijiqike Formation, thick sand bodies of delta front were widely developed, medium and fine sandstones accounted for more than 85% and grains had strong compressive capacity. After that, this reservoir experienced long-term shallow burial in the early-medium stage and rapid deep burial in the late stage and

the burial compaction effect was weaker. In the late stage, a canopy structure was formed from the overlying Paleogene thick gypsum salt bed due to thrust and compression, and it further suppressed vertical compaction. In the meantime, the study area was far from the orogenic belt and the structural transition zone, so the lateral compressive stress was weak. Therefore, the primary intergranular pores were preserved in large quantities. It is concluded that coarse lithology, weak compaction and low tectonic stress are the key factors to the development of this ultra-deep high-quality reservoir. In addition, the development of large-scale effective reservoirs deeper than 7 000 m provides favorable material conditions for the high-abundance enrichment of natural gas and the reserves of trillion cubic meters in the Kuqa Depression, and the oil and gas exploration potential is huge.  
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**Number of references:** 29

**Main heading:** Low permeability reservoirs

**Controlled terms:** Compaction - Flow of gases - Gases - Geological surveys - Lithology - Oil wells - Petroleum reservoir engineering - Porosity - Proven reserves - Risk assessment - Sandstone - Textures

**Uncontrolled terms:** Deeper than 7 000 m - Early Cretaceous - Formation mechanism - Gas exploration - Kuqa depression - Sandstone reservoirs - Tarim Basin - Ultra deeps

**Classification code:** 481.1 Geology - 482.2 Minerals - 512 Petroleum and Related Deposits - 631.1.2 Gas Dynamics - 914.1 Accidents and Accident Prevention - 931.2 Physical Properties of Gases, Liquids and Solids

**Numerical data indexing:** Percentage 4.00e+00% to 1.30e+01%, Percentage 8.50e+01%, Size 7.00e+03m, Size 7.60e+03m

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**Database:** Compendex

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48.

**Accession number:** 20201208317924

**Title:** Failure control and integrity technologies of tubing/casing string under complicated working conditions: Research progress and prospect

**Title of translation:** 复杂工况油套管柱失效控制与完整性技术研究进展及展望

**Authors:** Feng, Yaorong ; Fu, Anqing ; Wang, Jiandong ; Wang, Peng ; Li, Dongfeng ; Yin, Chengxian ; Liu, Hongtao

**Author affiliation:** State Key Laboratory of Performance and Structure Safety for

Petroleum Tubular Goods and Equipment Materials, CNPC  
Tubular Goods Research Institute, Xi'an; Shaanxi; 710077, China  
PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000,  
China

**Corresponding author:** Fu, Anqing (fuanqing@cnpc.com.cn)

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**Volume:** 40

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**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

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**Abstract:** As the exploration and development of deep carbonate reservoirs, new areas and shale oil and gas is strengthened, the stratigraphic conditions and the medium environments of oil and gas fields become more complex and demanding, and failure accidents happen from time to time, such as tubing/casing string deformation, connection leaking, collapse and fracturing. In addition, wells with special structure and special process and the special stimulation measures ask for new requirements on tubing/casing string. As a result, tubing/ casing string is faced with a series of new challenges and difficulties. After over 10 years' research, a series of experimental research progresses and important technological achievements have been obtained to meet the urgent need of reserves and production increase of domestic oil and natural gas industry and solve the technological difficulties of frequent tubing/casing string failure under complicated working conditions, e.g. deep and ultra-deep wells, wells with special structure and special process, and repeated acidizing fracturing of strong acid/high displacement and high-pressure. And these achievements are mainly as follows. First, corrosion material selection and evaluation of tubing/casing pipe, corrosion control and integrity technology of casing/tubing string based on the whole life cycle of a gas well is formed. Second, reliability design & evaluation and supporting technologies for the threaded connection structure and seal of tubing and casing are developed. Third, the casing string technology of "API long round threaded casing + CATT101 advanced thread compound"

suitable for the cost-effective efficient development of low-permeability tight gas wells is researched and developed. Fourth, the test platform and evaluation technology for the structure and seal integrity of casing/tubing string under complicated working conditions (e.g. high temperature and high pressure) are established. Then, based on domestic new needs and new problems in strengthening the exploration and development of oil and gas, some suggestions were proposed on continuing to carry out the research on failure control and integrity of casing/tubing string under complicated working conditions (such as deep layer, acidic environment and shale gas). In conclusion, these technological achievements provide powerful support for the cost-effective development of important oil and gas fields in China.

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**Number of references:** 30

**Main heading:** Oil field equipment

**Controlled terms:** Accidents - Cost effectiveness - Failure (mechanical) - Fracturing (fossil fuel deposits) - Gas industry - Gas permeability - Gases - Life cycle - Natural gas wells - Oil field development - Oil well production - Petroleum reservoir evaluation - Petroleum reservoirs - Pipeline corrosion - Proven reserves - Reserves to production ratio - Stratigraphy - Tight gas - Tubing - Well stimulation

**Uncontrolled terms:** Casing - Complex working condition - Corrosion control - Failure controls - Full scale tests - Integrity assessment - Premium connection

**Classification code:** 481.1 Geology - 511.1 Oil Field Production Operations - 511.2 Oil Field Equipment - 512 Petroleum and Related Deposits - 522 Gas Fuels - 619.1 Pipe, Piping and Pipelines - 911.2 Industrial Economics - 914.1 Accidents and Accident Prevention - 931.2 Physical Properties of Gases, Liquids and Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.02.012

**Database:** Compendex

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49.

**Accession number:** 20201208318036

**Title:** Formation mechanisms of deep and ultra-deep overpressure cap rocks and their relationships with super large gas fields in the petroliferous basins of China

**Title of translation:** 中国含油气盆地深层, 超深层超压盖层成因及其与超大型气田的关系

**Authors:** Li, Wei ; Yu, Ziliang ; Wang, Xueke ; Yu, Zhichao ; Lu, Xuesong ;

Feng, Qingfu

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration and Development, Beijing; 100083, China  
Beijing Research Center, CNOOC China Limited, Beijing; 100011, China

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**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Super large natural gas fields have been discovered in the deep and ultra-deep layers of onshore and offshore petroliferous basins in China since the beginning of the 21st century, and the geological conditions for the formation of these gas fields and their development laws have already been discussed in a large number of literatures, but the relationship between overpressure and the formation of this kind of gas fields is still less researched. In this regard, this paper firstly analyzed the gas reservoir development law, sealing conditions and overpressure characteristics of deep and ultra-deep super large gas fields. Then, the formation mechanisms of deep and ultra-deep overpressure cap rocks were investigated and the development law of deep and ultra-deep super large gas fields and their relationship with overpressure cap rocks were discussed. Finally, the favorable areas for the next exploration of deep and ultra-deep natural gas were pointed out. And the following research results were obtained. First, the formation of deep and ultra-deep super large gas fields is closely related to the development of overpressure cap rocks. Overpressure cap rock is a necessary condition for the formation of deep and ultra-deep super large gas fields, and there are three overpressure formation mechanisms, including pressure seal of salt-gypsum layer, pressure seal of residual uplift and pressure seal of hydrocarbon-generating pressurization. Second, as for deep and ultra-deep overpressure cap rocks and super large gas fields, there are four reservoir-cap rock assemblage modes under different pressure environments, i.e., overpressure salt-gypsum seal and

overpressure super large gas field (type I), internal overpressure compartment and overpressure super large gas field (type II), high-pressure argillaceous shale seal at the bottom of overpressure compartment and normal-pressure super larger gas field (type III), and overpressure source rock seal and normal-pressure super larger gas field (type IV). In conclusion, there are type I super large gas fields in the Kuqa Depression of the Tarim Basin, types II and III in the Junggar Basin, types I - IV in the Sichuan Basin and type IV in the Bohai Bay Basin.

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**Number of references:** 61

**Main heading:** Gases

**Controlled terms:** Barium compounds - Gas industry - Gasoline - Gypsum - Landforms - Natural gas - Offshore gas fields - Offshore oil well production - Petroleum reservoirs - Rocks

**Uncontrolled terms:** Bohai Bay Basin - Cap rock - Deep layer - Formation mechanism - Junggar Basin - Large gas field - Sichuan Basin - Tarim Basin - Ultra deeps

**Classification code:** 481.1 Geology - 482.2 Minerals - 511.1 Oil Field Production Operations - 512.1.1 Oil Fields - 512.2.1 Natural Gas Fields - 522 Gas Fuels - 523 Liquid Fuels

**DOI:** 10.3787/j.issn.1000-0976.2020.02.002

**Database:** Compendex

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50.

**Accession number:** 20203509114933

**Title:** Comparison of environmental and ecological effects between gas-fired and ultra-low emission coal-fired power generation plants

**Title of translation:** 燃气电厂与超低排放燃煤电厂环境及生态效应对比

**Authors:** Fan, Hui ; Duan, Tianyu ; Zhu, Boqi ; Chen, Shuangying

**Author affiliation:** CNPC Economics & Technology Research Institute, Beijing; 100724, China  
Jiangsu Branch of PetroChina Natural Gas Marketing Company, Nanjing; Jiangsu; 211100, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Issue date:** July 25, 2020

**Publication year:** 2020

**Pages:** 146-153

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Whether gas-fired power generation still has the comparative advantages in environmental protection and ecology compared with ultra-low emission (ULE) coal-fired power generation is an important factor to be considered in domestic power structure optimization decision in the future. Based on existing environmental protection standard of domestic fossil-fuel industry, this paper compared the environmental and ecological effects of gas-fired power generation with that of ULE coal-fired power generation from the aspects of pollutant emission level, issues caused by pollutants control, carbon emission and resource consumption. And the following research results were obtained. First, after low-nitrogen combustion modification and SCR installation are implemented in gas-fired power generation, its emission of conventional pollutants is much lower than that of ULE coal-fired power generation. Second, CO<sub>2</sub> emission per kilowatt hour of gas-fired power generation is about 50% lower than that of ULE coal-fired power generation. By means of gas-fired power generation, water and land resources can be saved greatly. Third, ULE coal-fired power generation suffers the emission problems of condensable particles (SO<sub>3</sub>) and heavy metals, so gas-fired power generation is much more advantageous in terms of environmental protection and ecological effect. Finally, several development suggestions were proposed. First, intensify environmental policies continuously and encourage the construction of gas-fired power generation plants. Second, by referring to NO<sub>x</sub> emission standard of gas turbines in Beijing and Shenzhen, revise the "Air Pollutant Emission Standard of Fossil-Fuel Power Plants (GB 13223-2011)" and set domestic NO<sub>x</sub> emission limit of gas turbines at 15 mg/m and cancel dust and SO<sub>2</sub> emission limits of gas turbine. Third, accelerate the construction and improvement of national carbon market and set the "floor price", establish a climate-friendly market environment of fair competition by virtue of carbon price mechanism, and speed up the transformation of electric power enterprises to the low-carbon power structure.

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**Number of references:** 24

**Main heading:** Gas turbine power plants

**Controlled terms:** Air pollution - Carbon - Coal - Coal combustion - Coal deposits - Coal industry - Commerce - Competition - Environmental protection - Fossil fuel power plants - Gas turbines - Gases - Heavy metals - Nitrogen oxides - Structural optimization

**Uncontrolled terms:** Air pollutant emission - Coal-fired power generation - Coal-fired power generation plant - Combustion modification - Comparative advantage - Electric power enterprise - Environmental protection standards - Power generation plants

**Classification code:** 451 Air Pollution - 454.2 Environmental Impact and Protection - 503 Mines and Mining, Coal - 524 Solid Fuels - 531 Metallurgy and Metallography - 612.3 Gas Turbines and Engines - 804 Chemical Products Generally - 804.2 Inorganic Compounds - 911.2 Industrial Economics - 921.5 Optimization Techniques

**Numerical data indexing:** Mass\_Density 1.50e-05kg/m<sup>3</sup>, Percentage 5.00e+01%

**DOI:** 10.3787/j.issn.1000-0976.2020.07.018

**Database:** Compendex

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51.

**Accession number:** 20202308799535

**Title:** Problems in the application of element logging and solutions

**Title of translation:** 元素录井应用中的问题及对策

**Authors:** Tang, Xie ; Yin, Ping ; Tang, Jiaqiong ; Yang, Lin ; Wu, Jiajie

**Author affiliation:** Geological Exploration & Development Research Institute, CNPC Chuanqing Drilling Engineering Co., Ltd., Chengdu; Sichuan; 610051, China

**Source title:** Natural Gas Industry

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**Issue date:** April 25, 2020

**Publication year:** 2020

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**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In recent years, element logging has been widely used in the field of oil and gas exploration, and it not only effectively solves the bottleneck problems of mud logging under the conditions of PDC bit and gas drilling, but also provides the powerful support for drilling engineering in terms of sublayer division, evaluation while drilling and geosteering to ensure its rapid, safe and efficient implementation. In the practical application of element logging, however, there are still some problems, which restrict its popularization and application. For this reason, this paper firstly analyzed the causes of the problems in the application of element logging. Then, the stability characteristics of each element were clarified by means of repetitive experiments and classified treatment was carried out. Finally, combined with data comparison and analysis results, the countermeasures and methods to solve the problems were put forward. And the following research results were obtained. First, there are some problems in the practical application of element logging, such as the instability of measurement data and the poor lateral comparability of numerical values. Second, the main causes of the problems in the application of element logging are the limitation of equipment manufacturing process and the restriction of field analysis conditions, which directly impact the stability, accuracy and reliability of data. Third, the repetitive experimental results show that the stability of major elements is generally good and the stability of trace elements is generally poor, so the classified treatment can guarantee the effective application of element logging. It is concluded that the selection of Si, Ca, Fe and Al as analysis treatment elements and the establishment of standardized treatment method can effectively guarantee the data accuracy of important elements. And the research results are conducive to the further popularization and application of element logging technology.

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**Number of references:** 18

**Main heading:** Logging while drilling

**Controlled terms:** Clarification - Infill drilling - Mud logging - Oil well logging - Petroleum prospecting - Reliability analysis - Stability - Trace elements

**Uncontrolled terms:** Bottleneck problem - Drilling engineering - Efficient implementation - Equipment manufacturing - Evaluation while drillings - Measurement data - Oil and gas exploration - Treatment methods

**Classification code:** 511.1 Oil Field Production Operations - 512.1.2 Petroleum Deposits : Development Operations - 802.3 Chemical Operations

**DOI:** 10.3787/j.issn.1000-0976.2020.04.006

**Database:** Compendex

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52.

**Accession number:** 20202308799570

**Title:** **Source and evolution of diagenetic fluid in the Middle Permian Maokou Formation in the southern Sichuan Basin**

**Title of translation:** 川南地区中二叠统茅口组成岩流体来源及演化过程

**Authors:** Ren, Mengyi ; Jiang, Qingchun ; Wang, Zecheng ; Huang, Shipeng ; Wu, Ya ; Xu, Liang

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration and Development, Beijing; 100083, China  
Shunan Division, PetroChina Southwest Oil & Gasfield Company, Luzhou; Sichuan; 646001, China

**Corresponding author:** Jiang, Qingchun (jiangqc@petrochina.com.cn)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Publication year:** 2020

**Pages:** 40-50

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Carbonate rocks in the Middle Permian Maokou Formation in the southern Sichuan Basin have experienced complex pore-fluid activities. So far, however, the coupling relationship between multi-stage diagenetic fluids and hydrocarbon fluids has been less researched from the perspective of microscopic geochemistry. For this reason, this paper firstly carried out core observation and thin section analysis on the Maokou Formation of this area. Then, petrology, rare earth elements, carbon and oxygen isotopes and fluid inclusions were analyzed. Finally, diagenetic environment, fluid source and fluid evolution of

Maokou Formation in different diagenetic stages were studied in the regional structure evolution setting. And the following research results were obtained. First, the Maokou Formation in this area experiences the diagenetic evolution process of "(pene)contemporaneous-eogenetic calcite cementation in the mixed water→epigenetic dissolution in the atmospheric freshwater→phyllomorphic calcite and dolomite cementation, metasomatism and acidic-fluid dissolution in the formation water". Second, the fluid sources in the process of sedimentation and diagenetism include seawater, atmospheric freshwater, hydrocarbon fluids and deep (thermal) fluids. Among them, the oxidized seawater is characterized by left-lead limestone REE, similar  $\delta C$  features to those of the global paleo-seawater, Eu positive anomaly of acidic hydrothermal fluid and obvious negative  $\delta C$ . And the evidence for the participation of the atmospheric freshwater is that the  $\delta O$  of the carbonate cements in fractures and dissolved pores is obviously negative. Third, the Maokou Formation experiences multi-phase hydrocarbon charging. During the Late Permian-Early Triassic, the Maokou Formation was uplifted and exposed to leaching, and the anomalous thermal of the Emei mantle plume led to formation dolomitization and hydrocarbon charging. Dissolution of atmospheric freshwater and organic acid, dolomitization and fracturing in this period play a constructive role for the Maokou Formation reservoir. Pressure dissolution and coarse-grained calcite cementation since the Jurassic play a role in destructing the Maokou Formation reservoir. And karst reservoirs associated with structural fractures are more conducive to later gas accumulation.

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**Number of references:** 39

**Main heading:** Dissolution

**Controlled terms:** Calcite - Cementing (shafts) - Exploratory geochemistry - Fracture - Hydrocarbons - Lime - Mineralogy - Rare earths - Seawater

**Uncontrolled terms:** Atmospheric freshwater - Carbon and oxygen isotopes - Coupling relationships - Diagenetic evolution - Hydrocarbon fluids - Hydrothermal fluids - Pressure dissolution - Structural fracture

**Classification code:** 471.4 Seawater, Tides and Waves - 481.2 Geochemistry - 482 Mineralogy - 802.3 Chemical Operations - 804.1 Organic Compounds - 804.2 Inorganic Compounds - 951 Materials Science

**DOI:** 10.3787/j.issn.1000-0976.2020.04.005

**Database:** Compendex

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53.

**Accession number:** 20200908220904

**Title:** A gas-bearing property identification method for deep reservoirs based on frequency-dependent AVO inversion

**Title of translation:** 基于频变AVO反演的深层储层含气性识别方法

**Authors:** Liu, Daoli ; Li, Kun ; Yang, Dengfeng ; Wei, Xuwang

**Author affiliation:** Research Institute, CNOOC China Limited Shenzhen Branch, Shenzhen; Guangdong; 510240, China

School of Geosciences, China University of Petroleum <East China>, Qingdao; Shandong; 266580, China

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**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** During the propagation of seismic wave in underground hydrocarbon bearing reservoirs, the phenomena of seismic amplitude attenuation and elastic characteristic dispersion happen, which makes it difficult to identify the fluids in deep hydrocarbon bearing reservoirs based on seismic data. In this paper, the fluid sensitivity degrees of a variety of frequency-dependent elastic parameters were analyzed based on the Chapman theoretical model of fractured-porous microstructure attenuation. And accordingly, the dispersion degree of Gassmann fluid term was selected as an identification factor for the gas-bearing prediction of deep reservoirs. Then, combined with the frequency spectrum decomposition method which is used for continuous wavelet conversion, spectrum analysis was carried out on some seismic data stacked with angle to determine the reference frequency. Based on this, the inversion optimization method of prestack seismic frequency-dependent Gassmann fluid term based on the Bayes Cauchy constraint criterion was researched, and the inversion result of frequency-dependent

Gassmann fluid term was used to guide reservoir fluid detection. Finally, this method was applied in P exploration area in one offshore basin of China to verify its role in gas-bearing prediction of deep reservoirs. And it is indicated that by virtue of this method, the frequency-dependent Gassmann fluid parameters based on prestack seismic data can be extracted reliably, and correspondingly the identification results of deep reservoir fluid are better consistent with the actual logging interpretation results. In conclusion, the frequency-dependent Gassmann fluid term is conducive to identifying deep reservoirs effectively and provides a new idea and method for the identification of deep gas layers.

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**Number of references:** 19

**Main heading:** Oil bearing formations

**Controlled terms:** Dispersion (waves) - Forecasting - Gas bearings - Gases - Hydrocarbons - Offshore oil well production - Petroleum reservoirs - Seismic prospecting - Seismic response - Seismic waves - Spectrum analysis - Wavelet decomposition

**Uncontrolled terms:** Deep reservoirs - Fluid factors - Fluid identification - Frequency dependent - Gassmann fluid term - Spectral decomposition

**Classification code:** 484 Seismology - 511.1 Oil Field Production Operations - 512.1.1 Oil Fields - 601.2 Machine Components - 804.1 Organic Compounds - 921.3 Mathematical Transformations

**DOI:** 10.3787/j.issn.1000-0976.2020.01.006

**Database:** Compendex

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54.

**Accession number:** 20201208317057

**Title:** Reservoir space and potential reservoir-formation areas in deep bedrock gas reservoirs in Altun forelands, Qaidam Basin: Recognition and discussion

**Title of translation:** 柴达木盆地阿尔金山前深层基岩气藏储集空间再认识与成储潜力区探讨

**Authors:** Li, Jiangtao ; Fu, Suotang ; Wang, Renyi ; Liu, Yingru ; Wang, Haicheng ; Ao, Wenbo ; Ma, Teng

**Author affiliation:** PetroChina Qinghai Oilfield Company, Dunhuang; Gansu; 736202, China  
PetroChina Changqing Oilfield Company, Xi'an; Shaanxi; 710018, China  
Zhejiang Ocean University, Zhoushan; Zhejiang; 316022, China

Research Institute of Petroleum Exploration & Development -  
Northwest, PetroChina, Lanzhou; Gansu; 730020, China

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source title:** Natur. Gas Ind.

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**Publication year:** 2020

**Pages:** 90-96

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The discovery of deep bedrock gas reservoirs in Altun forelands in the Qaidam Basin has expanded a new field of natural gas exploration and development in China. Since then, it has always been believed that the storage space of this kind of gas reservoirs is composed of well-developed dual media of matrix pores and fractures, but the practices of such gas reservoir development began to be in contradiction with this cognition. In order to achieve a better understanding of the storage space and the main controlling factors of reservoir formation in this bedrock gas reservoir, it is necessary to investigate the dissolved increased pores characteristics and the forced fractures characteristics in the bedrock gas reservoir. Then, based on the data such as cores and cast thin sections in the bedrock intervals in the Dongping 1 and Jiantan 1 blocks, the main storage space types of deep bedrock gas reservoirs in Altun forelands were analyzed, then the main controlling factors of favorable target reservoirs in these blocks were put forward, and in combination with the regional geological background, the geological understandings of favorable target reservoirs and potential reserves were deepened in this study area. The following research results were achieved. (1) The lithology of the bedrock gas reservoirs in this area consists of calc-alkaline igneous rocks and gneiss suite regional metamorphic rocks. Matrix pores are not developed, and their development degree is mainly controlled by faults. Main effective storage spaces and permeable channels are structural fractures and dissolution fractures. (2) The main controlling factors of target reservoir formation include lithology, tectonic effect, weathering, intrusive dikes, and on the whole the rule of ternary-control is followed, namely prevalent lithology-dominant stresses-hydrocarbon accumulations in the structural higher parts.

(3) The potential zones of reservoir formation include the following 5 types: tectonically stress concentrated tension-torsional zones, contact zones between lithologic interfaces of intrusive body, weathering zones of compressing uplift, slope sediment zones near circumscribed erosion area, para-conformity or unconformity interface.

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**Number of references:** 16

**Main heading:** Petroleum reservoirs

**Controlled terms:** Digital storage - Fracture - Gases - Igneous rocks - Lithology - Metamorphic rocks - Natural gas fields - Proven reserves - Structural geology - Weathering

**Uncontrolled terms:** Altun forelands - Gas reservoir - Main controlling factors - Potential area - Qaidam basin

**Classification code:** 481.1 Geology - 512 Petroleum and Related Deposits - 722.1 Data Storage, Equipment and Techniques - 951 Materials Science

**DOI:** 10.3787/j.issn.1000-0976.2020.02.010

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55.

**Accession number:** 20202508845038

**Title:** Technologies for the efficient development of tight sandstone gas reservoirs in narrow channels: A case study of Middle Jurassic Shaximiao Formation gas reservoir in the Zhongjiang Gas Field of western Sichuan Basin

**Title of translation:** 窄河道致密砂岩气藏高效开发技术-以川西地区中江气田中侏罗统沙溪庙组气藏为例

**Authors:** Duan, Yongming ; Zeng, Yan ; Liu, Chengchuan ; Chen, Jun ; Bi, Youyi ; Liu, Bin

**Author affiliation:** Exploration and Development Research Institute, Sinopec Southwest Oil & Gas Company, Chengdu; Sichuan; 610051, China

Sinopec Southwest Oil & Gas Company, Chengdu; Sichuan; 610051, China

Engineering Technology Institute, Sinopec Southwest Oil & Gas Company, Deyang; Sichuan; 618000, China

**Corresponding author:** Chen, Jun (1009731503@qq.com)

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**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The gas reservoir of Middle Jurassic Shaximiao Formation in the Zhongjiang Gas Field of western Sichuan Basin is characterized by complex structure and strong heterogeneity, which brings great challenges to its efficient development. In this paper, a series of technologies suitable for the efficient development of tight sandstone gas reservoirs in narrow channels were researched and developed. And they have been practically applied to the gas reservoir of Middle Jurassic Shaximiao Formation in the Zhongjiang Gas Field of western Sichuan Basin. And the following application results were obtained. First, the multi-domain and multi-attribute fine description technology is suitable for the complex and narrow channel sand bodies. By virtue of this technology, the spatial distribution characteristics of multi-stage overlapping channel sand bodies are described well, and the sedimentary time sequence of each channel sand body is also defined very clearly. Second, by virtue of the "three-phase" quantitative prediction technology of lithofacies, physical facies and fluid facies, the high-precision quantitative prediction of thin-layer lithofacies and physical facies is realized, the channel sand body with a thickness of 5-8 m can be identified, with a coincidence rate of lithology prediction being close to 100%, and the error of predicted reservoir thickness and porosity being less than 10%. Third, it is expected to obtain high and stable production of gas wells in the areas which satisfy the following conditions, e.g. effectively matched source rock fault and channel sand body, a distance of 5-25 km from the fault, high ancient and modern structures or high ancient structures and low modern structures, and good reservoir physical properties. Fourth, the adoption of three-dimensional well group deployment technology, well type selection technology and optimal horizontal well design technology greatly improves the reserve producing degree of tight sandstone gas reservoirs in narrow channels while saving the investment. Fifth, by virtue of the optimized fast drilling technology of horizontal well, the average drilling cycle of this gas reservoir is shortened from 101 d to 54 d. Based on the application of the staged fracturing technology of geology-

engineering integration, the single-well gas production rate rises steadily. The single-well average gas production in 2013-2019 is 10.8 times higher than that before 2012, which indicates a remarkable stimulation effect. In conclusion, this series of technologies for the efficient development of tight sandstone gas reservoirs in narrow channels provide powerful support for the construction of the second largest continental gas field of western Sichuan Basin in the Zhongjiang Gas Field.

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**Number of references:** 16

**Main heading:** Gas industry

**Controlled terms:** Gases - Horizontal wells - Infill drilling - Lithology - Natural gas well production - Petroleum reservoirs - Proven reserves - Sand - Sandstone - Structural geology - Tight gas - Well stimulation

**Uncontrolled terms:** Distribution characteristics - Drilling technology - Quantitative prediction - Reservoir physical property - Reservoir thickness - Shaximiao Formation - Strong heterogeneities - Western Sichuan basin

**Classification code:** 481.1 Geology - 482.2 Minerals - 483.1 Soils and Soil Mechanics - 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 522 Gas Fuels

**Numerical data indexing:** Percentage 1.00e+01%, Percentage 1.00e+02%, Size 5.00e+00m to 8.00e+00m, Size 5.00e+03m to 2.50e+04m

**DOI:** 10.3787/j.issn.1000-0976.2020.05.007

**Database:** Compendex

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56.

**Accession number:** 20201208317665

**Title:** Control effects of temperature and thermal evolution history of deep and ultra-deep layers on hydrocarbon phase state and hydrocarbon generation history

**Title of translation:** 深层, 超深层温度及热演化历史对油气相态与生烃历史的控制作用

**Authors:** Ren, Zhanli ; Cui, Junping ; Qi, Kai ; Yang, Guilin ; Chen, Zhanjun ; Yang, Peng ; Wang, Kun

**Author affiliation:** State Key Laboratory of Continental Dynamics, Northwest University, Xi'an; Shaanxi; 710069, China  
Department of Geology, Northwest University, Xi'an; Shaanxi; 710069, China  
Longdong University, Qingyang; Gansu; 745000, China

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**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Deep and ultra-deep layers in the oil and gas bearing basins of China are characterized by large temperature difference and complicated thermal evolution history. The control effects of temperature and thermal evolution history on the differences of hydrocarbon phase states and the hydrocarbon generation history in deep and ultra-deep layers are researched less and unsystematically. To deal with this situation, based on a large number of temperature and pressure data of deep layers and combined with the complicated historical situation of deep layer evolution in the oil and gas basins of China, the effects of temperature, heating time and pressure on the hydrocarbon formation temperature and phase state were analyzed, and the type of temperature and pressure relationship was classified. Finally, based on the classification of thermal evolution history of deep and ultra-deep layers, the control effects of thermal evolution history of the basins with different types of thermal history on the hydrocarbon generation and phase state were discussed. And the following research results were obtained. First, the hydrocarbon phase states of deep layers in different basins and regions are greatly different, and they are mainly affected by temperature, heating time, heating rate, pressure, source rock type and other factors. And temperature is the most important factor controlling hydrocarbon generation and phase state distribution. Second, under the conditions of rapid temperature increase and short heating time, there still may be oil reservoirs and condensate gas reservoirs in deep and ultra-deep layers in the case of high temperature. Third, overpressure inhibits hydrocarbon generation and pyrolysis. Fourth, there is a close relationship between temperature and formation pressure of deep layers, which can be divided into three types, i.e., low-medium temperature and high pressure type, high temperature and high pressure type, and medium temperature and low-medium pressure type. Fifth, the thermal evolution history of

deep and ultra-deep layers can be divided into four types, namely the late rapid subsidence, heating and low geothermal gradient type, the late rapid subsidence, heating and high geothermal gradient type, the middle-late rapid heating and late uplifting and cooling type, and the early great subsidence and rapid heating and middle-late great uplift erosion and cooling type. In conclusion, deep and ultra-deep layers in the basins with different types of thermal history are different in hydrocarbon phase states, accumulation stages and prospects.

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**Number of references:** 42

**Main heading:** Temperature

**Controlled terms:** Heating - Hydrocarbons - Petroleum prospecting - Petroleum reservoir engineering - Petroleum reservoirs - Subsidence

**Uncontrolled terms:** Abnormal pressure - Accumulation periods - Deep layer - Geothermal gradients - Heating time - Hydrocarbon phase - Superimposed basin - Thermal evolution history - Ultra deeps

**Classification code:** 483.1 Soils and Soil Mechanics - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 641.1 Thermodynamics - 804.1 Organic Compounds

**DOI:** 10.3787/j.issn.1000-0976.2020.02.003

**Database:** Compendex

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57.

**Accession number:** 20201708556784

**Title:** Identification and oil and gas exploration practices of reworked residual paleovolcanic edifice in the Junggar Basin

**Title of translation:** 准噶尔盆地改造残留古火山机构判识与油气勘探实践

**Authors:** Huang, Yun ; Liang, Shuyi ; Jia, Chunming ; Gu, Xinping ; Mao, Haibo ; Fu, Xiaopeng

**Author affiliation:** Exploration and Development Research Institute, PetroChina Xinjiang Oilfield Company, Urumqi; Xinjiang; 830013, China  
School of Geosciences and Technology, China University of Petroleum - East China, Qingdao; Shandong; 266580, China

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**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** By now, no any operable identification technology system has been developed for the Carboniferous volcanic edifice in the belly area of the Junggar Basin which is deformed due to multi-stage tectonic movement and weather-worn reworking, which restricts the exploration and development process of the Carboniferous volcanic gas reservoirs in this area. By analyzing the identification characteristics (e.g. the outcrop volcanic crater, the typical lithological combination of volcanic crater facies, the resistivity section inversed by the electric field sounding, the seismic facies and the seismic attributes), this paper summarized the comprehensive identification methods and the key seismic data processing technologies for the volcanic edifices in this area and defined the distribution characteristics of high-quality volcanic reservoirs. In addition, the areas favorable for the distribution of high-quality volcanic reservoirs were predicted by taking Jinlong and Kelameili gas fields as examples, so as to provide the guidance for the selection of well test horizons. And the following research results were obtained. First, the recognition of the outcrop paleovolcanic edifice pattern around the Junggar Basin can provide a reliable physical model for the identification of the deep-seated paleovolcanic edifice in the basin, which is of great significance to the basin-mountain integrated study. Second, cryptoexplosive breccia, fused volcanic breccia, perlite and spherulite rhyolite are important lithologic signs to identify paleovolcanic craters. High-quality volcanic reservoirs are mainly distributed in the volcanic breccia of explosive facies and the volcanic lava of overflow facies. Third, by virtue of gravity and magnetic exploration, volcanic rocks and sedimentary rocks can be distinguished, but the vertical resolution is low. This defect is made up for by the method of artificial electric field sounding. The form and occurrence of volcanic rocks represented in the resistivity inversion section can be used as the basis for the identification of volcanic edifice. Fourth, the seismic section method can identify the vertical characteristics of volcanic edifice and 3D seismic attribute can provide the areal distribution information of volcanic edifice, but neither of them can work without high-quality seismic data. In conclusion, seismic data processing and imaging technology is the key technology to identify the reworked residual volcanic edifices. In addition, the

proposed comprehensive volcanic edifice identification method presents good application results, thus it can be used to predict the areal distribution of a volcanic reservoir, so as to guide well deployment, geological engineering design and well test horizon selection.

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**Number of references:** 18

**Main heading:** Volcanic rocks

**Controlled terms:** Buildings - Data handling - Distributed database systems - Economic geology - Electric fields - Imaging techniques - Lithology - Magnetic prospecting - Oil wells - Petroleum prospecting - Petroleum reservoirs - Reservoirs (water) - Sedimentary rocks - Seismic response - Seismic waves - Volcanoes - Well testing

**Uncontrolled terms:** Distribution characteristics - Exploration and development - Identification method - Identification technology - Oil and gas exploration - Seismic data processing - Vertical characteristics - Vertical resolution

**Classification code:** 402 Buildings and Towers - 441.2 Reservoirs - 481.1 Geology - 481.4 Geophysical Prospecting - 482.2 Minerals - 484 Seismology - 484.2 Secondary Earthquake Effects - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 701.1 Electricity: Basic Concepts and Phenomena - 701.2 Magnetism: Basic Concepts and Phenomena - 723.2 Data Processing and Image Processing - 723.3 Database Systems - 746 Imaging Techniques

**DOI:** 10.3787/j.issn.1000-0976.2020.03.004

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

58.

**Accession number:** 20203509114386

**Title:** Determination of secondary shoulder clearance of double-shoulder tool joints suitable for extra-deep wells

**Title of translation:** 适合特深井的双台肩钻杆接头副台肩间隙的确定

**Authors:** Chen, Feng ; Zhu, Wei ; Di, Qinfeng ; Wang, Wenchang ; Chen, Wei ; Wang, Nan

**Author affiliation:** School of Mechatronics Engineering and Automation, Shanghai University, Shanghai; 200072, China  
Shanghai Institute of Applied Mathematics and Mechanics, School of Mechanics and Engineering Science, Shanghai University, Shanghai; 200072, China

**Corresponding** Di, Qinfeng (qinfengd@sina.com)

**author:****Source title:** Natural Gas Industry**Abbreviated** Natur. Gas Ind.**source title:****Volume:** 40**Issue:** 7**Issue date:** July 25, 2020**Publication year:** 2020**Pages:** 90-96**Language:** Chinese**ISSN:** 10000976**CODEN:** TIGOE3**Document type:** Journal article (JA)**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In order to meet the requirements of more and more severe drilling conditions, the major drilling tool manufacturers all over the world continuously develop special thread tool joints with premium performance. In general, the structure of secondary shoulder is adopted to form a double-shoulder tool joint. However, it has not been concerned whether the secondary shoulder clearance of the existing tool joints can meet the requirements of the complex working conditions of ultra-deep wells and extra-deep wells. In this paper, a three-dimensional elastoplastic finite element model of a double-shoulder tool joint with different secondary shoulder clearances was established. Then, the influence of secondary shoulder clearance on the stress distribution and torsion performance of tool joints was analyzed. Finally, the secondary shoulder clearance of double-shoulder tool joints suitable for extra-deep wells was determined. And the following research results were obtained. First, under different axial loads (corresponding to different well depths), the secondary shoulder clearance has a great influence on the bearing ratio of primary shoulder, secondary shoulder and thread tooth of double-shoulder tool joints. Second, under the action of large axial force, the bearing capacity of primary shoulder and secondary shoulder are smaller while that of thread tooth is larger, and reducing the secondary shoulder clearance can effectively reduce the bearing ratio of thread tooth. Third, for the NC50 double-shoulder tool joint analyzed in this paper, it is suggested to set the secondary shoulder clearance at 0.40 mm when the axial force is less than 3 000 kN (well depth is less than 9 000 m). Fourth, it is suggested to set the secondary shoulder clearance at 0.20 mm when the axial force is more than 3 000 kN (well depth is over 9 000 m). In conclusion, selecting the double-shoulder tool joint with a rational secondary shoulder clearance according to well depth can effectively improve the application

performance of joints and reduce failure risks.

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**Number of references:** 24

**Main heading:** Axial flow

**Controlled terms:** Infill drilling

**Uncontrolled terms:** Application performance - Axial forces - Bearing ratio - Drilling tool - Elastoplastic finite elements - Research results - Thread tooth - Ultra-deep wells

**Classification code:** 511.1 Oil Field Production Operations - 631.1 Fluid Flow, General

**Numerical data indexing:** Force 3.00e+06N, Size 2.00e-04m, Size 4.00e-04m, Size 9.00e+03m

**DOI:** 10.3787/j.issn.1000-0976.2020.07.011

**Database:** Compendex

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59.

**Accession number:** 20202908938171

**Title:** **Enrichment model of normal-pressure shale gas in the Jinbo slope of the basin-margin transition zone in Southeast Chongqing**

**Title of translation:** 渝东南盆缘转换带金佛斜坡常压页岩气富集模式

**Authors:** He, Guisong ; He, Xipeng ; Gao, Yuqiao ; Wan, Jingya ; Zhang, Peixian ; Zhang, Yong ; Gao, Hequn

**Author affiliation:** Research Institute of Exploration and Development, Sinopec East China Company, Nanjing; Jiangsu; 210011, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 6

**Issue date:** June 25, 2020

**Publication year:** 2020

**Pages:** 50-60

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Recently, the newly drilled shale gas well in the Jinfo slope of the transition zone along the margin of the southeast Chongqing Basin produced a high-yield gas flow from the Upper Ordovician Wufeng Formation and the Lower Silurian Longmaxi Formation with a formation pressure coefficient being up to 1.18, demonstrating a great breakthrough in the exploration of normal pressure shale gas in this area. In order to evaluate the exploration potential of this type of shale gas reservoirs, this paper analyzed the basic geological characteristics and the shale gas enrichment rules of shale gas reservoirs in the Jinfo slope based on drilling, geophysical exploration and test data. Then, the main factors controlling the enrichment and high yield of normal-pressure shale gas were summarized, and the shale gas enrichment model was established. Finally, the favorable target area for the exploration and development of normal-pressure shale gas in this area was predicted. And the following research results are obtained. First, the high-quality shale in this area is characterized by good gas generation conditions, high siliceous mineral content, good reservoir physical properties and high gas content, presenting a greater shale gas exploration potential. Second, the enrichment and high yield of normal-pressure shale gas follows the rule of "three-factor gas control", i.e., sedimentary facies controlling hydrocarbon supply and reservoirs, tectonic movement controlling preservation and enrichment, and in-situ stress field controlling fractures and production. Third, the sealing capacity of the sealing reverse thrust fault which is developed in the updip direction of the slope-type target layer is conducive to the formation of a good preservation unit in the fault footwall. As the burial depth and the distance from the denudation boundary increase, the shale gas enrichment degree and the single-well production rate increase. In conclusion, the research results enrich the geological theory of normal-pressure shale gas and provide support for the exploration and development of normal-pressure shale gas in the complex tectonic areas, especially in the slopes, in southern China.

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**Number of references:** 20

**Main heading:** Petroleum prospecting

**Controlled terms:** Faulting - Flow of gases - Gases - Geological surveys - Infill drilling - Mineral exploration - Natural gas well production - Petroleum reservoirs - Shale gas - Stresses

**Uncontrolled terms:** Exploration and development - Exploration potential - Geological characteristics - Geophysical exploration - In-situ stress field - Reservoir physical property - Shale gas reservoirs - Single well production

**Classification** 481.1 Geology - 484.1 Earthquake Measurements and Analysis -

**code:** 501.1 Exploration and Prospecting Methods - 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 522 Gas Fuels - 631.1.2 Gas Dynamics

**DOI:** 10.3787/j.issn.1000-0976.2020.06.005

**Database:** Compendex

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60.

**Accession number:** 20202308799558

**Title:** A new method for evaluating the unstable deliverability of gas wells in gas formation testing phase

**Title of translation:** 试气阶段评价气井不稳定产能的新方法

**Authors:** Feng, Xi ; Peng, Xian ; Li, Qian ; Zhao, Xiaoliang ; Zhang, Ping ; Pan, Deng

**Author affiliation:** Exploration and Development Research Institute, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610041, China

College of Petroleum Engineering, China University of Petroleum, Beijing; 102249, China

Engineering Technology Department, CNPC Chuanqing Drilling Engineering Co., Ltd., Chengdu; Sichuan; 610051, China

Drilling & Production Technology Research Institute, CNPC Chuanqing Drilling Engineering Co., Ltd., Guanghan; Sichuan; 618300, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

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**Issue date:** April 25, 2020

**Publication year:** 2020

**Pages:** 59-68

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Predicting the deliverability change laws of a gas well in the early stage is one of the technical difficulties in natural gas development. The commonly used steady seepage analysis

methods have relatively large errors. And this problem cannot be solved effectively by the classical methods of production decline analysis and pressure transient well test analysis. To solve this problem, this paper did calculation based on the well testing model of constant-pressure production, changed the previous approximate method of simplifying the calculation of the exponential integral function, and accurately calculated the analytical solution of absolute open flow potential of a gas well. In addition, the deliverability instability characteristics of different types of gas wells were quantitatively described by taking vertical wells in homogeneous reservoirs as the reference benchmark. Then, combined with the deliverability evaluation needs of a new well, a new practical method focusing on solving the problems of gas formation testing analysis was researched and developed, and also applied on site at some key wells in the hot spots of natural gas development in the Sichuan Basin. And the following research results were obtained. First, the accurate formula for the analytical solution of well testing model significantly enhances the adaptability to shortterm test conditions. Second, the newly established chart briefly reveals the quantitative relationship between the unstable deliverability characteristics of a gas well and the main influencing factors. Third, if the characteristic parameter of turbulence effect is unknown, it is necessary to perform iterative calculation of the variable skin factor when the well testing model of constant-pressure production is used to analyze the change trend of the absolute open flow potential of a gas well. Fourth, by conducting comparative analysis on the calculation results of typical cases, the decline laws of the absolute open flow potential of different types of gas wells can be understood further. It is concluded that this new method is capable of improving the prediction accuracy of the unstable deliverability of gas wells. Therefore, it can be widely applied to the deliverability evaluation of gas wells in the exploration stage, the evaluation stage of early development and the commissioning stage of new development and production wells, which is conducive to the formulation of natural gas exploration and development decision.

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**Number of references:** 32

**Main heading:** Natural gas wells

**Controlled terms:** Analytical models - Gases - Iterative methods - Natural gas - Natural gas well production - Petroleum prospecting - Petroleum reservoir evaluation - Well testing

**Uncontrolled terms:** Absolute open flow potential - Exponential integral functions - Instability characteristics - Iterative calculation - Natural gas development - Natural gas exploration - Production decline analysis - Technical difficulties

**Classification** 512.1.2 Petroleum Deposits : Development Operations - 512.2.1

**code:** Natural Gas Fields - 522 Gas Fuels - 921 Mathematics - 921.6  
Numerical Methods

**DOI:** 10.3787/j.issn.1000-0976.2020.04.007

**Database:** Compendex

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61.

**Accession number:** 20202308799547

**Title:** **Dynamic characteristics of production pump valve under the working conditions of low submergence and high inclination well sections**

**Title of translation:** 大斜度井段低沉没度工况排采泵阀动力学特性

**Authors:** Liu, Xinfu ; Liu, Chunhua ; He, Hongming ; Zhou, Chao ; Wang, Dexiang

**Author affiliation:** School of Mechanical and Automotive Engineering, Qingdao University of Technology, Qingdao; Shandong; 266520, China  
Key Laboratory of Industrial Fluid Energy Conservation and Pollution Control, Ministry of Education, Qingdao; Shandong; 266520, China  
College of Mechanical and Electronic Engineering, China University of Petroleum <East China>, Qingdao; Shandong; 266580, China  
CNOOC Research Institute Ltd., Beijing; 100028, China

**Corresponding author:** Liu, Chunhua (20090053@upc.edu.cn)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 4

**Issue date:** April 25, 2020

**Publication year:** 2020

**Pages:** 97-103

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** At present, the mechanical behaviors of the pump valve of sucker

rod pump in coal measure gas wells are studied mainly by transplanting and referring to the analysis methods for the pump valve of sucker rod pump in conventional oil and gas wells, which mostly focus on the oil and wells with higher submergence depth without taking into account the influences of pump valve dynamics and hydraulic friction under the working conditions of low submergence depth and high inclination well section or defining the specific conditions for the smooth start up of the pump valve in horizontal wells. In this paper, the differential equation set for the movement of the pump valve in the kick off section with the well fluid was derived by comprehensively considering the coupling influences of low submergence depth and high inclination. Then, the mathematical model for the hydraulic friction of fluid while it flows through the clearance of pump valve in the sucker rod pump was established. Finally, the dynamics, hydraulic friction and critical submergence depth of the pump valve in horizontal wells were analyzed based on numerical simulation methods. And the following research results were obtained. First, under the coupling action of low submergence depth and high inclination, the increase of stroke and frequency can lead to the increase of the lift, velocity and acceleration of the valve ball of the pump valve in the kick off section, and the reduction of the time for the acceleration to reach the flat value. In addition, the valve ball suffers short-term cyclical fluctuation the moment the pump valve in the horizontal well is started. Second, under the double action of spring force and valve ball gravity, the critical submergence depth of the sucker rod pump in horizontal wells is much lower than that in vertical wells, and the fixed valve ball can be reset quickly, which is beneficial to the opening of fixed and travelling valve balls in horizontal wells and the improvement of pump efficiency. Third, the increase of stroke, frequency and pump diameter can increase the critical submergence depth and the hydraulic friction of fluid while it flows through the pump valve of sucker rod pump in the horizontal well. In addition, increasing stroke is more beneficial to increase the pump inlet velocity of low-rate well fluid while the critical submergence depth is increased significantly. In conclusion, the research results are of great significance to ensuring the continuous and stable production of coal measure gas wells and improving the reliability of sucker rod pumps.

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**Number of references:** 23

**Main heading:** Oil well pumps

**Controlled terms:** Coal industry - Differential equations - Flow of fluids - Friction - Gas industry - Horizontal wells - Natural gas well production - Natural gas wells - Numerical methods - Pumps - Valves (mechanical)

**Uncontrolled** Conventional oil and gas - Critical submergences - Dynamic

**terms:** characteristics - High inclination well - Hydraulic friction - Mechanical behavior - Numerical simulation method - Travelling valves

**Classification code:** 503 Mines and Mining, Coal - 512.1.1 Oil Fields - 512.2.1 Natural Gas Fields - 522 Gas Fuels - 524 Solid Fuels - 601.2 Machine Components - 618.2 Pumps - 631.1 Fluid Flow, General - 921.2 Calculus - 921.6 Numerical Methods

**DOI:** 10.3787/j.issn.1000-0976.2020.04.012

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

62.

**Accession number:** 20202308799543

**Title:** Relationship between geological structure and marine shale gas preservation conditions in the western Middle Yangtze Block

**Title of translation:** 中扬子地块西部地区结构构造与页岩气保存条件的关系

**Authors:** Chen, Kongquan ; Zhang, Douzhong ; Tuo, Xiusong

**Author affiliation:** Hubei Cooperative Innovation Center of Unconventional Oil and Gas, Yangtze University, Wuhan; Hubei; 430100, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 4

**Issue date:** April 25, 2020

**Publication year:** 2020

**Pages:** 9-19

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Lower Paleozoic dark shale is developed in the western Middle Yangtze Block, which lays a material foundation for the enrichment and accumulation of marine shale gas. In order to ascertain the control action of geological structures on the differential preservation of shale gas and reveal the key factors in shale gas preservation, this paper firstly analyzed the structure characteristics of this area, carried out structure pattern

recognition and structural belt division, and studied structural deformation mode and intensity. Based on this, the relationships between different structure styles and shale gas preservation conditions were analyzed. Finally, combined with the structural deformation and the lithofacies paleogeographic characteristics of marine shale, the favorable exploration zones of shale gas were proposed. And the following research results were obtained. First, the western Middle Yangtze Block can be divided into four structural deformation zones, and three types of piggyback structural patterns have been identified, including restricted type, weakly reformed type and strongly reformed type. Second, the restricted type is located in the northwestern part of Hunan and Hubei Provinces. In this pattern, piggyback structure is incomplete and thrust belt and compression fold belt are developed. Third, the weakly and strongly reformed types are located in the western parts of Hunan and Hubei, and Wulingshan area, respectively. They both have complete piggyback structures, but the former has lower deformation intensity and has never undergone the late superimposed reformation. Fourth, there are three structural transfer belts in the western Middle Yangtze Block, i.e. the structural transfer belt between the East Sichuan fault-fold belt and West Hunan-Hubei fault-fold belt, the structural transfer belt between West Hunan-Hubei fault-fold belt and Wulingshan fault-fold belt, and the structural transfer belt between the outcrop and the hinterland of Middle Yangtze Block. The first one is structurally transformed at the Qiyueshan fault. The East Sichuan fault-fold belt on the west is an ejective fold with low fault density and formation denudation intensity, where shale gas is enriched in anticlines and slopes; while the West Hunan-Hubei fault-fold belt on the east is a trough-like fold with strong faulting and high formation denudation intensity, where shale gas is enriched in residual synclines. In conclusion, shale gas preservation conditions of Upper Ordovician Wufeng Formation-Lower Silurian Longmaxi Formation in this area are the best in Zigui syncline, thrust-detachment zone and western margin of Qiyueshan fault. The favorable exploration areas of shale gas of Lower Cambrian Niutitang Formation are distributed in the western flank of Yichang slope, Kaixian thrust zone, compression fold zone and thrust-detachment zone.

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**Number of references:** 28

**Main heading:** Faulting

**Controlled terms:** Deformation - Erosion - Gases - Pattern recognition - Petroleum prospecting - Shale gas

**Uncontrolled terms:** Deformation intensity - Different structure - Enrichment and accumulations - Geological structures - Preservation condition - Structural deformation - Structural pattern - Structure characteristic

**Classification** 484.1 Earthquake Measurements and Analysis - 512.1.2 Petroleum  
**code:** Deposits : Development Operations - 522 Gas Fuels  
**DOI:** 10.3787/j.issn.1000-0976.2020.04.002  
**Database:** Compendex

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63.

**Accession** 20202308799549  
**number:**

**Title:** **Mechanism of wellbore instability in continental shale gas horizontal sections and its water-based drilling fluid countermeasures**

**Title of translation:** 陆相页岩气水平井段井壁失稳机理及水基钻井液对策

**Authors:** Wang, Bo ; Sun, Jinsheng ; Shen, Feng ; Li, Wei ; Zhang, Wenzhe

**Author affiliation:** School of Petroleum Engineering, China University of Petroleum <East China>, Qingdao; Shandong; 266580, China  
 Research Institute, Shaanxi Yanchang Petroleum <Group> Co. Ltd., Xi'an; Shaanxi; 710075, China  
 CNPC Engineering Technology R&D Co. Ltd., Beijing; 102206, China

**Corresponding author:** Sun, Jinsheng (sunjinsheng@petrochina.com.cn)

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**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 4

**Issue date:** April 25, 2020

**Publication year:** 2020

**Pages:** 104-111

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The wellbore instability in the horizontal sections of continental shale gas wells in the Ordos Basin is a major engineering and technical problem that restricts the exploration and development of the shale gas resources in the Yanchang Formation of Upper Triassic of Mesozoic in the Yanchang Block. To solve this problem,

this paper analyzed the characteristics of mineral components in shale by means of X-ray diffraction. In addition, its physical and chemical characteristics, specific surface area and microstructure were analyzed. On this basis, a shale water-based drilling fluid system (PSW-2) of low free water activity based on nano plugging was developed. And it was applied on site at five horizontal wells in continental shale gas reservoirs to ensure the wellbore stability of their long horizontal sections. And the following research results were obtained. First, the Yanchang Formation shale in this area has a high content of clay mineral, and it is a fractured formation of weak expansion, easy dispersion and multiple bedding, so the wellbore instability here is the result of the comprehensive action of mechanical factors, physical and chemical factors, drilling mechanical disturbance, etc. Second, the shale has average pore diameter is 4.494-8.502 nm and is characterized by obvious capillary action, strong water absorption capacity and uneven hydration, which result in the decrease of local shale strength, so sudden collapse tends to happen easily. Third, the API loss of PSW-2 system is less than 2.8 mL, the rolling recovery rate is 95.15% (close to the recovery rate of oil-based drilling fluid 98.25%), the linear expansion rate is as low as 1.38%, and the wetting angle increases from 26° of dry rock samples to 56.5°. Fourth, the compressive strength of the system after immersion increases to 95.806 MPa, which is close to the original rock strength (110.70 MPa). It is concluded that this water-based drilling fluid system can effectively ensure wellbore stability by blocking the pores of shale with micro nano components, reducing the activity of liquid phase to increase the inhibition, and weakening the multi-element collaboration of the capillary imbibition effect of shale.

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**Number of references:** 22

**Main heading:** Exploratory boreholes

**Controlled terms:** Chemical analysis - Compressive strength - Drilling fluids - Energy resources - Expansion - Horizontal drilling - Horizontal wells - Infill drilling - Oil field equipment - Oil wells - Petroleum prospecting - Petroleum reservoirs - Shale gas - Stability - Water absorption - Wetting

**Uncontrolled terms:** Exploration and development - Fractured formations - Mechanical disturbance - Oil-based drilling fluid - Physical and chemical characteristics - Water absorption capacity - Water based drilling fluids - Wellbore instability

**Classification code:** 511.1 Oil Field Production Operations - 511.2 Oil Field Equipment - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 525.1 Energy Resources and Renewable Energy Issues - 802.3 Chemical Operations - 951 Materials Science

**Numerical data indexing:** Percentage 1.38e+00%, Percentage 9.52e+01%, Percentage 9.82e+01%, Pressure 1.11e+08Pa, Pressure 9.58e+07Pa, Size 4.49e-09m to 8.50e-09m, Volume 2.80e-06m<sup>3</sup>

**DOI:** 10.3787/j.issn.1000-0976.2020.04.013

**Database:** Compendex

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64.

**Accession number:** 20201708556862

**Title:** Policy-driven clean heating modes in the rural areas of the northern China

**Title of translation:** 政策驱动下的中国北方农村地区清洁取暖方式

**Authors:** Zhou, Shuhui ; Sun, Hui ; Wang, Chenlong ; Liang, Yan

**Author affiliation:** PetroChina Planning and Engineering Institute, Beijing; 100083, China

Beijing Municipal Institute of Labour Protection, Beijing; 100050, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 3

**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 146-156

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Clean heating in the rural areas of the northern China in winters is an important part of the energy consumption revolution and rural lifestyle revolution, and it is also a major livelihood project and a heart-warming project. Therefore, it is widely concerned to give considerations to its economy, applicability and environmental requirements. In this paper, "2+26" cities in the Beijing-Tianjin-Hebei area and its periphery, which is an important area with clean heating in the countryside, were taken as the research object. Based on field survey and household measurement, four main clean heating methods (wall-mounted gas boiler,

regenerative electric heater, air source heat pump and clean coal heating) in this area were analyzed and compared in terms of technology, economy and environment. In addition, some specific suggestions were proposed. And the following research results were obtained. First, wall-mounted gas boiler is a more cost-effective alternative to coal-fired heating, but the access to product's energy efficiency and emission shall be controlled strictly. It is recommended to popularize energy-saving and environmentally-friendly condensing wall-mounted boilers in cities and in economically developed rural areas. Second, there are no thermal insulation measures in existing buildings in rural areas and heating energy consumption is high, so more attention shall be paid to thermal insulation measures. And it is suggested to carry out energy-saving transformation on houses and provide appropriate subsidies while promoting clean heating, and to propel the centralized heating during the construction of new urbanization in rural areas. Third, clean-coal heating will still exist in some rural areas for a long time. Therefore, it is necessary to strengthen the supervision of coal quality, and it is recommended to adopt a set of "clean coal + special stove + carbon monoxide monitoring" measures. Fourth, it is necessary to adopt measures according to local conditions. That is to choose the appropriate heating path and heating equipment on the basis of local resource characteristics. In the areas with abundant renewable energy and good grid supporting conditions, it is advisable to focus on the popularization of regenerative electric heaters or air source heat pumps for heating. Fifth, to ensure the stable operation of rural areas in the era of "post coal to gas and coal to electricity", it is recommended that the state shall conduct a comprehensive study on the formulation of subsidy exit mode and precise subsidies for poor households after the exit and strengthen the implementation of environmental protection policies and green development concepts, so as to truly reach the goal of "affordable transformation, affordable utilization, and content utilization".

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**Number of references:** 22

**Main heading:** Air source heat pumps

**Controlled terms:** Boilers - Carbon monoxide - Coal - Coal industry - Coal research - Cost effectiveness - Electric heat treatment - Electric heating - Energy efficiency - Energy utilization - Rural areas - Thermal insulation - Walls (structural partitions)

**Uncontrolled terms:** Environmental requirement - Heating energy consumption - Insulation measures - Local conditions - Renewable energies - Research results - Stable operation - Supporting conditions

**Classification code:** 408.2 Structural Members and Shapes - 413.2 Heat Insulating Materials - 524 Solid Fuels - 525.2 Energy Conservation - 525.3 Energy Utilization - 537.1 Heat Treatment Processes - 614 Steam

Power Plants - 616.1 Heat Exchange Equipment and Components  
 - 642.1 Process Heating - 804.2 Inorganic Compounds - 911.2  
 Industrial Economics

**DOI:** 10.3787/j.issn.1000-0976.2020.03.018

**Database:** Compendex

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65.

**Accession number:** 20201208317996

**Title:** Exploration status of the deep Sinian strata in the Sichuan Basin: Formation conditions of old giant carbonate oil/gas fields

**Title of translation:** 从古老碳酸盐岩大油气田形成条件看四川盆地深层震旦系的勘探地位

**Authors:** Zhao, Wenzhi ; Wang, Zecheng ; Jiang, Hua ; Fu, Xiaodong ; Xie, Wuren ; Xu, Anna ; Shen, Anjiang ; Shi, Shuyuan ; Huang, Shipeng ; Jiang, Qingchun

**Author affiliation:** PetroChina Research Institute of Petroleum Exploration & Development, Beijing; 100083, China  
 PetroChina Hangzhou Institute of Geology, Hangzhou; Zhejiang; 310023, China

**Corresponding author:** Wang, Zecheng (wangzecheng@petrochina.com.cn)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

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**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** To construct a giant Sichuan gas province, it is in an urgent need of exploring new replacement areas with abundant natural gas resources and great exploration potential. In this paper, the formation conditions (e.g. source rock, reservoir and play) and the distribution laws of the deep-seated old giant marine carbonate

oil/gas fields in China's Craton Basins were investigated systematically. Then, the accumulation and enrichment conditions of deep Sinian natural gas in the Sichuan Basin were analyzed. Finally, potential and favorable target zones of natural gas exploration in the Dengying Formation of Upper Sinian were evaluated. And the following research results were obtained. First, the effectiveness and scale of source kitchens, reservoirs and reservoir-caprock assemblages and the proximity are the necessary conditions for the formation of deep-seated giant carbonate oil/gas fields, and paleo-uplifts, paleo-slopes and paleo-fault zones are the favorable areas of searching deep-seated giant carbonate oil/gas fields. Second, in the Sichuan Basin, three sets of high-quality source rocks are developed in the Neoproterozoic-Cambrian System, and their maturity of organic matter is still in the optimal window for cracking gas, so the gas generation scale is large. Third, after the microbial carbonate rocks of Dengying Formation in the Sichuan Basin were reconstructed by constructive diagenesis, effective reservoirs are formed and distributed widely. Fourth, owing to the integrated source rocks and cap rocks of Dengying Formation, the marginal platform and the intra platform have favorable conditions for proximal hydrocarbon accumulation. In conclusion, the deep Sinian in the Sichuan Basin has good conditions of hydrocarbon accumulation and it is an important replacement area of natural gas exploration. Paleo-uplifts and slopes in the central Sichuan Basin have been the favorable locations of natural gas accumulation for a long period. Large-scale exploration shall focus on four favorable areas, including the marginal platform zone in the fourth Member of Dengying Formation, the marginal platform zone in the second Member of Dengying Formation, the bioherm beach body of Dengying Formation intra platform in the paleo-uplifts and slopes of the central Sichuan Basin, and the bioherm beach body of Dengying Formation in the eastern Sichuan Basin.

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**Number of references:** 32

**Main heading:** Petroleum prospecting

**Controlled terms:** Beaches - Carbonates - Carbonation - Energy resources - Gases - Geological surveys - Hydrocarbons - Natural gas - Natural gas fields - Oils and fats - Petroleum deposits - Reefs - Sedimentary rocks

**Uncontrolled terms:** Cap rock - Enrichment and accumulations - Giant gas province - Microbial carbonates - Sichuan Basin - Sinian

**Classification code:** 407.3 Coastal Engineering - 481.1 Geology - 482.2 Minerals - 512 Petroleum and Related Deposits - 522 Gas Fuels - 525.1 Energy Resources and Renewable Energy Issues - 802.2 Chemical Reactions - 804.1 Organic Compounds - 804.2 Inorganic Compounds

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**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

66.

**Accession number:** 20202508844999

**Title:** **Seismic stepped prediction technology for tight sandstone gas sweet spot in coal measure strata: A case study of the Submember 2 of the Lower Permian Shanxi Formation along the southeastern margin of the Ordos Basin**

**Title of translation:** 煤系地层致密砂岩气甜点区地震逐级预测-以鄂尔多斯盆地东南缘下二叠统山西组2亚段为例

**Authors:** Li, Guobin ; Zhang, Yajun ; Xie, Tianfeng ; Shi, Xiaoqian ; Wang, Ronghua ; Li, Xingtao ; Liu, Xiongzhi ; Jing, Ziyang

**Author affiliation:** Research Institute of Petroleum Exploration & Development-Northwest, PetroChina, Lanzhou; Gansu; 730020, China  
PetroChina Coalbed Methane Company Limited, Beijing; 100028, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 5

**Issue date:** May 25, 2020

**Publication year:** 2020

**Pages:** 34-42

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The Submember 2 of the Lower Permian Shanxi Formation (hereinafter, "Shan 2 Submember" for short) in the southeastern Ordos Basin is an important target of natural gas exploration in this basin. However, the reservoir of Shan 2 Submember is characterized by small thickness, fast thickness variation and strong heterogeneity, and its reservoir prediction and exploration target selection is difficult. In order to accurately predict the sweet spots of tight sandstone gas in the coal measure strata and improve its success rate of exploration, this paper proposed a seismic stepped prediction technology based on the

characteristics and prediction difficulties of this reservoir, including the 90° phase-shifting technology to determine channel outline, the model constrained wave impedance inversion to characterize sandbody thickness, and the wavelet attenuation gradient attribute to identify gas-bearing sand bodies. And the following research results were obtained. First, Shan 2 Submember is overlain by No.5 coal bed of strong seismic reflection and its underlying formation has weak seismic reflection energy. In addition, there is a sparse 2D seismic grid and a low well control degree. Therefore, tight sandstone gas sweet spot prediction is high difficulty. Second, under the constraint of seismic stepped prediction, the proposed technology can be used to efficiently characterize the distribution of channel sand bodies and identify effective gas-bearing reservoirs, so as to increase the prediction accuracy of exploration and development targets. Third, the exploration and development targets deployed on the basis of this technology present a good drilling effect, the seismic prediction result has high lateral resolution, and the variation characteristics of channels and channel sand bodies are reflected truly. In conclusion, the application of this method can solve the geological difficulties of predicting tight sandstone gas sweet spots in strong-heterogeneity thin reservoirs of coal measure strata in a 2D seismic exploration area.

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**Number of references:** 36

**Main heading:** Oil bearing formations

**Controlled terms:** Coal - Coal deposits - Coal industry - Forecasting - Gas bearings - Gases - Metamorphic rocks - Petroleum prospecting - Sandstone - Seismic prospecting - Seismic waves - Seismology - Tight gas

**Uncontrolled terms:** Exploration and development - High-lateral resolution - Natural gas exploration - Phase-shifting technology - Prediction technologies - Strong heterogeneities - Variation characteristics - Wave impedance inversion

**Classification code:** 482.2 Minerals - 484 Seismology - 484.1 Earthquake Measurements and Analysis - 503 Mines and Mining, Coal - 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 522 Gas Fuels - 524 Solid Fuels - 601.2 Machine Components

**DOI:** 10.3787/j.issn.1000-0976.2020.05.004

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

67.

**Accession** 20202508844793

**number:****Title:** Genesis and source of shallow natural gas in the Jiyang Depression of the Bohai Bay Basin**Title of translation:** 渤海湾盆地济阳坳陷浅层天然气成因及其来源**Authors:** Gao, Changhai ; Zhang, Yunyin ; Wang, Xingmou**Author affiliation:** Key Laboratory of Deep Oil and Gas, China University of Petroleum-East China, Qingdao; Shandong; 266580, China  
Geophysical Research Institute, Sinopec Shengli Oilfield Company, Dongying; Shandong; 257000, China**Source title:** Natural Gas Industry**Abbreviated source title:** Natur. Gas Ind.**Volume:** 40**Issue:** 5**Issue date:** May 25, 2020**Publication year:** 2020**Pages:** 26-33**Language:** Chinese**ISSN:** 10000976**CODEN:** TIGOE3**Document type:** Journal article (JA)**Publisher:** Natural Gas Industry Journal Agency**Abstract:** There are abundant Paleogene and Neogene shallow natural gas resources in the Jiyang Depression of the Bohai Bay Basin, but their genesis and sources have been controversial. In order to provide theoretical support for the exploration of shallow natural gas in the Jiyang Depression, this paper analyzed the geochemical characteristics of shallow natural gas in this area based on the test data of gas compositions, light hydrocarbon fingerprints and carbon isotopes. Then, the genetic types of shallow natural gas were determined. Finally, the sources of shallow natural gas were discussed. And the following research results were obtained. First, shallow natural gas in the Jiyang Depression is mainly composed of methane and its dry coefficient is high (over 95%), so it is classified as typical dry gas. Second, light hydrocarbon has a low n-alkane content and high isoparaffin content, so it presents as oil-type gas with biodegradation characteristics. Third, The carbon isotopes of methane are lighter (-55.7‰&uyuml; -42.3‰), the carbon isotopes of ethane and propane are reversed, and the carbon isotopes of CO<sub>2</sub> are heavier, so it has the characteristics of typical crude oil degradation gas and wet gas composition transformation. In conclusion, shallow natural gas in the Jiyang Depression is mixed secondary gas of biogenesis and

thermogenetic transformation, which is the biodegradation product of conventional oil reservoirs. It is composed of crude oil degradation gas and oil-dissolved released gas, and the proportion of crude oil degradation gas is more than 60%. What's more, shallow natural gas in heavy oil areas shall be taken as an important exploration and development target for reserves and production increase in the Jiyang Depression.

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**Number of references:** 39

**Main heading:** Proven reserves

**Controlled terms:** Biodegradation - Carbon - Crude oil - Exploratory geochemistry - Gases - Heavy oil production - Hydrocarbons - Isotopes - Methane - Natural gas - Natural gas deposits - Paraffins - Petroleum industry - Petroleum reservoir engineering - Petroleum reservoirs - Reserves to production ratio

**Uncontrolled terms:** Biodegradation characteristics - Biodegradation products - Exploration and development - Geochemical characteristic - Jiyang Depression - Light hydrocarbon - Natural gas resources - Production increase

**Classification code:** 461.8 Biotechnology - 481.2 Geochemistry - 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 522 Gas Fuels - 804 Chemical Products Generally - 804.1 Organic Compounds

**Numerical data indexing:** Percentage 6.00e+01%, Percentage 9.50e+01%

**DOI:** 10.3787/j.issn.1000-0976.2020.05.003

**Database:** Compendex

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68.

**Accession number:** 20201708556877

**Title:** Identification and characterization of multi-scale pores, vugs and fractures in carbonate reservoirs: A case study of the Middle Permian Qixia dolomite reservoirs in the Shuangyushi Structure of the northwestern Sichuan Basin

**Title of translation:** 碳酸盐岩储层多尺度孔洞缝的识别与表征--以川西北双鱼石构造中二叠统栖霞组白云岩储层为例

**Authors:** Wang, Junjie ; Hu, Yong ; Liu, Yicheng ; He, Puwei ; Lan, Xuemei ; Wen, Wen

**Author affiliation:** Exploration and Development Research Institute, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610041, China

PetroChina Southwest Oil & Gasfield Company, Chengdu;  
Sichuan; 610000, China

**Corresponding author:** Hu, Yong (huyong@petrochina.com.cn)

**Source title:** Natural Gas Industry

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**Volume:** 40

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**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 48-57

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** As for the carbonate reservoirs with strong heterogeneity and multi-scale reservoir spaces, it is difficult to identify all the reservoir spaces using only one single test method. In order to provide technical support for a fine characterization and efficient development of carbonate oil and gas reservoirs, this paper took the dolomite reservoir of Middle Permian Qixia Formation in the Shuangyushi structure of the northwestern Sichuan Basin as the research object. Considering there are multi-scale pores, vugs and fractures developed in the reservoir, core image acquisition instrument and dual-energy CT were used to characterize pores, vugs and fractures in the cores of different scales, and the 3D visualization software was applied to quantitatively analyze the reconstructed pore spaces. In this way, the characterization of the matching relationship of pores, vugs and fractures at different scales and the division of reservoir types were realized, and a set of methods for fracture and vug identification based on geometric parameters was developed. And the following research results were obtained. First, multi-scale reservoir spaces of pores, vugs and fractures are developed in the reservoirs of Qixia Formation in this area, and they can be divided into 6 types of 3 categories. Pores are dominated by intercrystalline dissolution pores and intergranular pores, vugs are mainly small ones, and fractures are mainly diagonal fractures. Second, a set of methods for fracture and vug identification based on geometric parameter is set up. And it takes the sphericity  $<0.43$  and the spherical radius ratio  $<0.41$  as the fracture identification standard and the equivalent spherical radius  $>2$  mm as the vug identification standard. Third, the pores in the reservoirs of Qixia Formation are

mainly large pores with a diameter ranging from 0.02 to 2.00 mm, the vugs are mainly small with a diameter ranging from 2.00 to 10.00 mm, and fractures of multiple scales are developed. Fourth, the Qixia Formation dolomite reservoirs are mainly of fracture-vug type and fracture-pore type. The development degree of fractures and vugs is a key factor affecting the physical properties of the Qixia Formation reservoirs. The reservoir types with developed fractures in the Qixia Formation account for more than 50%. Therefore, its percolation capacity is better.

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**Number of references:** 24

**Main heading:** Fracture

**Controlled terms:** Carbonation - Computerized tomography - Parameter estimation - Petroleum reservoir engineering - Petroleum reservoirs - Solvents - Testing - Textures - Three dimensional computer graphics

**Uncontrolled terms:** Carbonate reservoir - Development degree - Dolomite reservoirs - Fracture identification - Intergranular pores - Oil and gas reservoir - Strong heterogeneities - Technical support

**Classification code:** 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 723.5 Computer Applications - 802.2 Chemical Reactions - 803 Chemical Agents and Basic Industrial Chemicals - 951 Materials Science

**Numerical data indexing:** Percentage 5.00e+01%, Size 2.00e-03m to 1.00e-02m, Size 2.00e-05m to 2.00e-03m

**DOI:** 10.3787/j.issn.1000-0976.2020.03.006

**Database:** Compendex

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69.

**Accession number:** 20201708556838

**Title:** Design and plugging property of composite pressure activated sealant

**Title of translation:** 复合压差激活密封剂的设计及其封堵性能

**Authors:** Xu, Lin ; Jiang, Mengchen ; Xu, Jie ; Xu, Mingbiao ; Meng, Shuang ; Wang, Dongxu

**Author affiliation:** College of Petrochemical and Energetic Engineering, Zhejiang Ocean University, Zhoushan; Zhejiang; 316022, China  
Institute of Exploration Techniques, Chinese Academy of Geological Sciences, Langfang; Hebei; 065000, China  
College of Petroleum Engineering, Yangtze University, Wuhan; Hubei; 430100, China

**Corresponding author:** Xu, Mingbiao (xmb62@163.com)

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**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 107-114

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Pressure activated sealant (PAS), as a novel kind of sealing fluid, can provide rapid and self-adapting repair on the tiny damage of static seals (e.g., screws and pipelines) while encountering pressure difference of leakage sites, but its sealing property is affected more by the size of leakage site, so it exhibits limited application in the production and wellbore integrity recovery of oil & gas wells. To extend PAS's applicability, this paper put forward a composite PAS technology involving the cooperativity of solid and liquid sealing materials for enhancing large pore plugging based on the phase state transition and sealing behaviors of sealing fluid under the action of pressure difference. In this technology, two types of solid sealing materials (bridging rigid particle and tension reinforcing fiber) were used jointly to modify the geometries of leakage pores and the migration paths of fluids, which can promote the formation of effective solid barrier from the PAS to fill in large leaking pores, so as to perform sealing repair. And the following laboratory experimental results were obtained. First, the newly prepared PAS is a kind of polydisperse system, and the core particles are regular in shape with the size distribution mainly in a range of 300-400  $\mu\text{m}$ . Second, in the range of evaluation pressure, sepiolite fiber, as the structure promoter, reinforces the integrity of sealing solids. Third, mussel powder, as the pore structure modifier, improves the retention ability of the sealing fluid in the limited leakage space. These two sealing materials not only cooperatively improve the structure of solid barrier, but also markedly enhance the plugging effect of composite PAS in large pores. In conclusion, these research results can provide theoretical and technical support for the development and application of novel multifunctional

sealants in oil & gas wells.

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**Number of references:** 25

**Main heading:** Seals

**Controlled terms:** Leakage (fluid) - Natural gas well production - Natural gas wells - Oil field development - Oil well production - Oil wells - Pore structure - Repair - Sealants

**Uncontrolled terms:** Development and applications - Polydisperse systems - Pressure differences - Pressure-activated sealants - Reinforcing fibers - Research results - Retention ability - Technical support

**Classification code:** 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 619.1.1 Pipe Accessories - 913.5 Maintenance - 931.2 Physical Properties of Gases, Liquids and Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.03.013

**Database:** Compendex

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70.

**Accession number:** 20200908220933

**Title:** Finite element analysis on the nonlinear static force of Menggang River large suspension cable crossing pipeline under the finished state of bridge

**Title of translation:** 勐岗河大型悬索跨越管道成桥状态下非线性静力有限元分析

**Authors:** Peng, Yang ; An, Jianchuan ; Li, Ming ; Yu, Jin ; Li, Changjun

**Author affiliation:** Gas Management Office, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610215, China

PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610056, China

Petroleum Engineering School, Southwest Petroleum University, Chengdu; Sichuan; 610500, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 1

**Issue date:** January 25, 2020

**Publication year:** 2020

**Pages:** 125-131

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The Menggang River suspension cable crossing pipeline of the natural gas pipeline engineering from Chuxiong of Yunnan to Panzhihua of Sichuan is erected directly across the river, so the deformation and stress induced in the process of pigging shall not be ignored. In order to clarify the initial conditions of pigging dynamic response characteristics, it is necessary to perform finite element analysis on the nonlinear static force under the finished state of bridge. In this paper, a 1:1 simulation model was firstly established based on the ANSYS Workbench software. Then, the stresses in different sections of the crossing structure under its own gravity load at a certain arch height were analyzed. Finally, by applying different static loads on the crossing line pipe, the stress and displacement of the line pipe were calculated and checked. And the following research results were obtained. First, the stress and displacement of the established simulation model of crossing structure with a certain arch height under its own gravity are lower than the allowable value, and the deviation from the field test data is smaller. Second, the maximum stress position of the line pipe under the working condition of pressure test appears at the beginning of the arch at the south bank bridge deck rather than at the center of the pipe. Third, with the increase of the applied load, the maximum stress and the displacement of the line pipe increase, but the overall displacement changes less and the stress first reaches the allowable stress value. Fourth, due to the influence of arch height, the displacement change of each part and the position of the ultimate stress of the crossing line pipe under external load have particularity. In conclusion, the research results lay a foundation for the subsequent researches on the pigging dynamic response of the same type of crossing structures.

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**Number of references:** 23

**Main heading:** Crossings (pipe and cable)

**Controlled terms:** Arch bridges - Arches - Cable suspended roofs - Cables - Computer software - Dynamic response - Finite element method - Gas engineering - Natural gas - Natural gas pipelines - Nonlinear analysis - Rivers - Stresses

**Uncontrolled terms:** Deformation and stress - Displacement - Dynamic response characteristics - Initial conditions - Nonlinear statics - Simulation calculation - Stress and displacements - Suspension cables

**Classification** 401.1 Bridges - 408.2 Structural Members and Shapes - 522 Gas

**code:** Fuels - 723 Computer Software, Data Handling and Applications - 921.6 Numerical Methods

**DOI:** 10.3787/j.issn.1000-0976.2020.01.017

**Database:** Compendex

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71.

**Accession number:** 20200908220889

**Title:** **Structural deformation laws and oil & gas exploration direction in the western Kelasu tectonic zone of the Tarim Basin**

**Title of translation:** 塔里木盆地克拉苏构造带西部构造变形规律与油气勘探方向

**Authors:** Yang, Haijun ; Sun, Xiongwei ; Pan, Yangyong ; Tang, Yongliang ; Li, Xiangyun ; Qu, Yuanji ; Jin, Jiangning ; Wu, Junlin

**Author affiliation:** Exploration and Development Research Institute, PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China  
Yingmai Oil and Gas Development Department, PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China

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**Publication year:** 2020

**Pages:** 31-37

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The western section of Kelasu tectonic zone in the Kuqa Depression of the Tarim Basin is faced with a series of difficulties such as complicated deformation, poor deep reservoir seismic imaging, difficult trap discovery and confirmation and low oil & gas exploration and development degree. In order to speed up the oil and gas exploration in this area, this paper analyzed the structural deformation characteristics in different sections of the Kelasu tectonic zone based on previous research results, combined with the latest drilling information and high-quality 3D

seismic data. Then, differential structural deformation laws, structural deformation characteristics and structural patterns of the Kelasu tectonic zone were studied, and the reasons for the intensive development of pop-up structures in the Keshen fault belt were analyzed. Finally, the oil & gas exploration direction in this area in the next step was pointed out. And the following research results were obtained. First, the differential structural deformation laws are controlled by three major factors in different sections, namely plastic gypsum-salt rock, regional compression stress and basement pre-structure. Second, under the effect of twin salt lakes, wedge-shaped thrust imbricated structures are developed in the Dabei Block. Third, the Bozi-Dabei Block is under the joint effect of oblique compressions, twin salt lakes and paleo-uplifts, and complete pop-up structures, large-scale echelon nappe structures and wedge-shaped thrust imbricated structures are developed. Fourth, the Bozi Block is hindered mainly by the paleo-uplift, and broken pop-up structures are developed. Fifth, the structural transition zone of Awate-Bozi Block is mainly affected by oblique compression stress and single salt lake, and wedge-shaped thrust imbricated structures are developed. In conclusion, pop-up structure group and echelon trap group that are generally developed in the Keshen fault belt and the Baicheng fault belt have huge oil & gas exploration and development potential, so they are the important exploration objects in this area.

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**Number of references:** 15

**Main heading:** Petroleum prospecting

**Controlled terms:** Buildings - Deformation - Faulting - Gases - Geological surveys - Gypsum - Lakes - Salt deposits - Seismology

**Uncontrolled terms:** Bozi Block - Compressionstress - Echelon - Gypsum-salt rocks - Structural transitions - Tarim Basin

**Classification code:** 402 Buildings and Towers - 481.1 Geology - 482.2 Minerals - 484.1 Earthquake Measurements and Analysis - 505.1 Nonmetallic Mines - 512.1.2 Petroleum Deposits : Development Operations

**DOI:** 10.3787/j.issn.1000-0976.2020.01.004

**Database:** Compendex

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72.

**Accession number:** 20203509114488

**Title:** New understandings and potential of Sinian-Lower Paleozoic natural gas exploration in the central Sichuan paleo-uplift of the Sichuan Basin

**Title of translation:** 四川盆地川中古隆起震旦系-下古生界天然气勘探新认识及勘探潜力

**Authors:** Xu, Chunchun ; Shen, Ping ; Yang, Yueming ; Zhao, Luzi ; Luo, Bing ; Wen, Long ; Chen, Kang ; Ran, Qi ; Zhong, Yuan ; Peng, Hanlin

**Author affiliation:** PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China

Exploration and Development Research Institute, PetroChina Southwest Oil & Gasfield Company, Chengdu; Sichuan; 610051, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 7

**Issue date:** July 25, 2020

**Publication year:** 2020

**Pages:** 1-9

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Since the Anyue Gasfield, located in the central Sichuan paleo-uplift of the Sichuan Basin, was discovered, great efforts have been made to work on natural gas exploration and discovery in the Sinian-Lower Paleozoic in the north slope of present paleo-uplift which has similar depositional settings. It is verified by the breakthrough of natural gas exploration in the second Member of Upper Sinian Dengying Formation in the north slope of central Sichuan paleo-uplift by wildcat well PT1 and the new sign of natural gas exploration in the Can-glangpu Formation of Lower Cambrian and the fourth Member of Dengying Formation by Well JT1 that there are also favorable conditions for the formation of large-scale gas province in the north slope. In order to determine the natural gas exploration potential of Sinian-Lower Paleozoic in the central Sichuan paleo-uplift and provide the guidance for the following exploration deployment, this paper analyzed the petroleum geological conditions of Sinian-Lower Paleozoic in the north slope. And the following research results were obtained. First, the marginal platform belts in the second and the fourth Member of Sinian Dengying Formation in the north slope are basically separated areally, and they are superior to the Gaomo area in terms of marginal platform width and sedimentary thickness and are intrinsically advantageous in sedimentation.

Second, compared with the Gaomo area, the reservoirs of Sinian Dengying Formation in the north slope are better in reservoir conditions, and many sets of quality reservoirs are developed vertically in Sinian-Cambrian. Third, hydrocarbon accumulation elements of Sinian Dengying Formation are better allocated in the north slope. Lithological traps are developed with a larger cumulative area. Wells JT1 and PT1 verify that there is gas in the lithological trap of the fourth and the second Member of Dengying Formation and large-scale lithological gas reservoirs are developed in the slope setting. In conclusion, compared with the Gaomo area, the Sinian-Lower Paleozoic in the north slope is superior in petroleum geological conditions and has the advantage of multi-layer stereoscopic exploration vertically, presenting a great natural gas exploration potential and promising exploration prospects, so it is a new important strategic zone of conventional natural gas exploration in the Sichuan Basin.

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**Number of references:** 17

**Main heading:** Petroleum prospecting

**Controlled terms:** Gases - Gasoline - Geological surveys - Lithology - Natural gas - Natural gas wells - Petroleum geology - Petroleum reservoirs - Stereo image processing - Wildcat wells

**Uncontrolled terms:** Dengying formation - Depositional setting - Exploration prospects - Favorable conditions - Geological conditions - Hydrocarbon accumulation - Natural gas exploration - Reservoir conditions

**Classification code:** 481.1 Geology - 512 Petroleum and Related Deposits - 522 Gas Fuels - 523 Liquid Fuels - 723.2 Data Processing and Image Processing

**DOI:** 10.3787/j.issn.1000-0976.2020.07.001

**Database:** Compendex

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73.

**Accession number:** 20203509114385

**Title:** **Discovery of carbonate source rock gas reservoir and its petroleum geological implications: A case study of the gas reservoir in the first Member of Middle Permian Maokou Formation in the Fuling area, Sichuan Basin**

**Title of translation:** 碳酸盐岩烃源岩气藏的发现及其油气地质意义-以四川盆地涪陵地区中二叠统茅口组一段气藏为例

**Authors:** Hu, Dongfeng ; Wang, Liangjun ; Zhang, Hanrong ; Duan, Jinbao ; Xia, Wenqian ; Liu, Zhujiang ; Wei, Quanchao ; Wang, Kun ; Pan,

Lei

**Author affiliation:** Sinopec Exploration Company, Chengdu; Sichuan; 610041, China**Source title:** Natural Gas Industry**Abbreviated source title:** Natur. Gas Ind.**Volume:** 40**Issue:** 7**Issue date:** July 25, 2020**Publication year:** 2020**Pages:** 23-33**Language:** Chinese**ISSN:** 10000976**CODEN:** TIGOE3**Document type:** Journal article (JA)**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Carbonate rocks in the first Member of Maokou Formation, Middle Permian in the Sichuan Basin (hereinafter "Mao 1 Member" for short) have been taken as a set of source rocks, and they have not been specifically studied from the aspects of reservoir evaluation and testing. By referring the exploration ideas of unconventional natural gas, the Fuling area of southeastern Sichuan Basin have obtained industrial gas flow in development well from Mao 1 Member in recent years. In order to clarify the natural gas exploration potential of Mao 1 Member in this area, it is necessary to study its sedimentary characteristics, natural gas reservoir forming conditions and main control factors based on the data of field section measurement, drilling system coring and laboratory testing. And the following research results were obtained. First, the gas reservoir in Mao 1 Member in the Fuling area is of source-reservoir integration, and its natural gas is mainly enriched in blackish gray marlite and nodular marlite. Second, its reservoir spaces are dominated by grain boundary pores (fractures), diagenetic shrinkage pores (fractures), organic pores and fractures. Third, the pores are mostly in a nanometerscale, and the main pore diameter is in the range of 5-50 nm, which is between shale reservoir and conventional reservoir and with a strong heterogeneity. Fourth, the gas reservoir is characterized by source-reservoir coexistence, lithology controlling reservoir and extensive layered distribution, presenting two-stage differential hydrocarbon enrichment, namely intraformational near-source enrichment in the early stage and interformational blowdown adjustment in the late stage. Fifth, the development of blackish gray organic-rich fine marlite which is deposited with the episodic upwelling in the outer ramp facies belt is the foundation for the formation of

natural gas reservoir, the transformation of clay minerals controls the development of quality reservoirs, good preservation condition is the key to the formation of natural gas reservoir, and fracture development is favorable for the enrichment and high yield of natural gas. In conclusion, Mao 1 Member in this area is a special type of gas reservoir, i.e., carbonate source rock gas reservoir, which has greater potential of natural gas exploration and industrial gas flow have been obtained in many wells. What's more, the discovery of such type of gas reservoirs not only expands the field of natural gas exploration in the Sichuan Basin, but provides the reference for the natural gas exploration in South China and other areas.

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**Number of references:** 33

**Main heading:** Natural gas wells

**Controlled terms:** Carbonation - Flow of gases - Fracture - Gases - Geological surveys - Grain boundaries - Lithology - Natural gas - Organic minerals - Petroleum geology - Petroleum prospecting - Petroleum reservoir evaluation - Petroleum reservoirs - Quality control - Rocks

**Uncontrolled terms:** Carbonate source rocks - Natural gas exploration - Natural gas reservoir - Pores and fractures - Preservation condition - Sedimentary characteristics - Strong heterogeneities - Unconventional natural gas

**Classification code:** 481.1 Geology - 482.2 Minerals - 512 Petroleum and Related Deposits - 522 Gas Fuels - 631.1.2 Gas Dynamics - 802.2 Chemical Reactions - 913.3 Quality Assurance and Control - 951 Materials Science

**Numerical data indexing:** Size 5.00e-09m to 5.00e-08m

**DOI:** 10.3787/j.issn.1000-0976.2020.07.003

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

74.

**Accession number:** 20202508844925

**Title:** Deep and ultra-deep natural gas exploration in the Sichuan Basin: Progress and prospect

**Title of translation:** 四川盆地深层-超深层天然气勘探进展与展望

**Authors:** Guo, Xusheng ; Hu, Dongfeng ; Huang, Renchun ; Wei, Zhihong ; Duan, Jinbao ; Wei, Xiangfeng ; Fan, Xiaojun ; Miao, Zhiwei

**Author affiliation:** Sinopec Exploration Company, Chengdu; Sichuan; 610041, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 5

**Issue date:** May 25, 2020

**Publication year:** 2020

**Pages:** 1-14

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** In recent years, major breakthroughs have been made in natural gas exploration in deep and ultra-deep strata in the Sichuan Basin, but the overall successful rate is low. To further clarify the prospects there, it is necessary to make an in-depth analysis of the previously discovered large-scale reef-shoal gas fields such as Puguang, Yuanba, Anyue and Longgang and deep shale gas discovery in Dingshan and Dongxi, southern Sichuan Basin. On one hand, large high-energy facies are the basis for controlling the development of large-scale reef-shoal reservoirs in conventional reef-shoal areas. The reservoir original porosity is high. The atmospheric freshwater dissolution in the early diagenetic stage, dolomitization, unconformity karst, and "pore-fracture coupling" mainly control the development of secondary pores. The contribution of hydrothermal fluids to reservoir is double-sided, and such early pores can be preserved till present due to those retention processes such as early hydrocarbon charging. Apart from continuous preservation as the key factor, most gas reservoirs are featured by "near-source enrichment, phase transformation, and dynamic adjustment". On the other hand, deep shale gas generally has the characteristics of "high pressure, high porosity, and high gas content", that is, "overpressure and rich gas". The key to the development of high-quality deep shales with high pores are "quartz compression retaining hole" and "reservoir fluid overpressure". The weak tectonic effect in the late stage is the main reason for deep shale gas to maintain the "high pressure and high gas content". In conclusion, technological advances like geological target identification and "sweet spot" prediction, as well as deep, high-temperature and high-pressure engineering processes, are the guarantee for efficient exploration of conventional and unconventional deep and ultra-deep natural gas, which has great potential in the Sichuan Basin.

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**Number of references:** 44

**Main heading:** Petroleum prospecting

**Controlled terms:** Gases - Geological surveys - High pressure effects - High pressure engineering - High temperature engineering - Natural gas - Natural gas wells - Petroleum reservoirs - Porosity - Reefs - Shale gas

**Uncontrolled terms:** Atmospheric freshwater - Dynamic adjustment - Engineering process - High temperature and high pressure - Hydrothermal fluids - Natural gas exploration - Target identification - Technological advances

**Classification code:** 481.1 Geology - 512 Petroleum and Related Deposits - 522 Gas Fuels - 931.2 Physical Properties of Gases, Liquids and Solids

**DOI:** 10.3787/j.issn.1000-0976.2020.05.001

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

75.

**Accession number:** 20201708556857

**Title:** A new well test interpretation model for complex fracture networks in horizontal wells with multi-stage volume fracturing in tight gas reservoirs

**Title of translation:** 致密气藏水平井多段体积压裂复杂裂缝网络试井解释新模型

**Authors:** Ouyang, Weiping ; Sun, Hedong ; Han, Hongxu

**Author affiliation:** Changqing Downhole Technology Company, CNPC Chuanqing Drilling Engineering Co., Ltd., Xi'an; Shaanxi; 710018, China  
PetroChina Research Institute of Petroleum Exploration & Development, Langfang; Hebei; 065007, China  
Project Supervision Department, PetroChina Changqing Oilfield Company, Xi'an; Shaanxi; 710018, China

**Corresponding author:** Sun, Hedong (sunhed@petrochina.com.cn)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 3

**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 74-81

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Multi-stage volume fracturing of horizontal wells is the main means to develop tight gas reservoirs. Complex fracture networks of various shapes are generated around the wellbore after volume fracturing. At present, however, most of the well test models suitable for fracturing horizontal wells take all hydraulic fractures as single main fractures, which results in a large error between well test interpretation result and actual situation. As a result, the fracture network characteristic parameters of the stimulated areas cannot be obtained accurately. To this end, a well test model for complex fracture networks in tight-gas fracturing horizontal wells was established on the basis of the non-structural discrete fracture model. Then, this model was solved by using the finite element method with combined triangular elements and linear elements. And accordingly, the well test type curves of a horizontal well under different fracture network patterns (rectangular, elliptical and hyperbolic) were prepared. Based on this, well test type curves were analyzed from the aspects of characteristics and influential factors and were compared with those obtained from the conventional single-fracture model. Finally, the new model was applied in well test interpretation of one multi-stage volume fracturing horizontal well in the gas reservoir of Permian Shan 1 Member in the Qingyang Gas Field of the Ordos Basin. And the following research results were obtained. First, the biggest difference of well test type curve between the fracture network model and the conventional single-fracture model occurs in the early stage, the characteristics of first linear flow regime are replaced with the characteristics of pseudo-radial flow regime in the stimulated area. Second, the end time of the pseudo-radial flow regime in the stimulated area is mainly dominated by the size and shape of the stimulated area. The larger the stimulated area is, the longer the pseudo-radial flow regime lasts. As the shape of the stimulated area approaches to be elongated, the characteristics of the well test type curve obtained by the new model are more consistent with those by the single-fracture model. Third, the pressure derivative value of the pseudo-radial flow regime in the stimulated area is mainly dependent on the conductivity and density of the fracture network. The higher the density or the conductivity of fracture network in the stimulated area is, the earlier the wellbore storage effect regime ends, the lower the pressure derivative value of the pseudo-radial flow regime in the stimulated area is and the more obvious the characteristics of the horizontal line are. In conclusion, case study results confirm that the new model is reliable and practical and can provide accurate reservoir

parameters as well as the size of the effectively stimulated area by volume fracturing and the conductivity of fracture network, which is conducive to evaluating the stimulation effect of volume fracturing and predicting the postfrac production performance.  
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**Number of references:** 27

**Main heading:** Horizontal wells

**Controlled terms:** Boreholes - Complex networks - Fracture - Gases - Oil field equipment - Petroleum reservoirs - Radial flow - Tight gas - Well stimulation - Well testing

**Uncontrolled terms:** Discrete-fracture models - Fracture network models - Production performance - Reservoir parameters - Tight gas reservoirs - Well test interpretation - Well test type curves - Wellbore storage effects

**Classification code:** 511.2 Oil Field Equipment - 512.1.1 Oil Fields - 522 Gas Fuels - 631.1 Fluid Flow, General - 722 Computer Systems and Equipment - 951 Materials Science

**DOI:** 10.3787/j.issn.1000-0976.2020.03.009

**Database:** Compendex

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76.

**Accession number:** 20201208318043

**Title:** Annulus pressure management of marine deepwater HTHP gas wells

**Title of translation:** 海洋深水高温高压气井环空带压管理

**Authors:** Luo, Ming ; Gao, Deli ; Li, Wentuo ; Zhang, Chao ; Yang, Yuhao ; Deng, Wenbiao

**Author affiliation:** MOE Key Laboratory of Petroleum Engineering, China University of Petroleum, Beijing; 102249, China  
CNOOC China Limited Zhanjiang Branch, Zhanjiang; Guangdong; 524057, China

**Corresponding author:** Li, Wentuo (liwt6@cnooc.com.cn)

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 2

**Issue date:** February 25, 2020

**Publication year:** 2020

**Pages:** 115-121

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The problem of annulus pressure is prominent in the development process of high-temperature and high-pressure (HTHP) oil and gas reservoirs in the South China Sea. And once the annulus pressure exceeds the allowable value, the safety of production will be impacted. Therefore, it is necessary to determine the range of reasonable annulus pressure in order to ensure the normal production of gas wells. Based on the recommended practice in ISO 16530-1:2017 and API RP 90-2, this paper researched and established a model for calculating the annulus pressure control value of deepwater HTHP gas wells while considering the pressure bearing capacity of pipe string and the check of key nodes, as well as a set of annulus pressure management chart. And the following research results were obtained. First, the calculation of the pressure bearing capacity of pipe string is mainly aimed at the tubing and casing corresponding to annulus. Second, the check calculation of key nodes mainly focuses on wellhead device, packer, downhole safety valve and liner hanger. Third, a model for calculating the minimum reserved annulus pressure is established to apply a certain backup pressure in the annulus of the deepwater gas wells with high formation pressure and that with high bottom hole flow pressure and ensure the normal operation of downhole strings and tools in the range of reasonable annulus pressure. Fourth, the calculation and analysis are carried out by taking one deepwater well as an example. The control values of annulus pressure with the change of commissioning time with and without considering the reduction of wall thickness are obtained. It is concluded that the proposed model and chart are simple and can be operated easily when they are used in marine deepwater HTHP gas wells, and they provide reference for annulus pressure management of deepwater HTHP wells and similar wells.

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**Number of references:** 19

**Main heading:** Reservoir management

**Controlled terms:** Bearing capacity - Gases - Offshore gas fields - Offshore gas well production - Offshore gas wells - Oil field equipment - Petroleum reservoir engineering - Pressure control - Tubing - Wellheads

**Uncontrolled terms:** Annulus pressures - Control values - Deepwater - High temperature and high pressure - South China sea

**Classification code:** 511.2 Oil Field Equipment - 512.1.2 Petroleum Deposits : Development Operations - 512.2.1 Natural Gas Fields - 619.1 Pipe, Piping and Pipelines - 731.3 Specific Variables Control

**DOI:** 10.3787/j.issn.1000-0976.2020.02.013

**Database:** Compendex

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77.

**Accession number:** 20200908220944

**Title:** Discovery of Well Bozi 9 and ultra-deep natural gas exploration potential in the Kelasu tectonic zone of the Tarim Basin

**Title of translation:** 博孜9井的发现与塔里木盆地超深层天然气勘探潜力

**Authors:** Tian, Jun ; Yang, Haijun ; Wu, Chao ; Mo, Tao ; Zhu, Wenhui ; Shi, Lingling

**Author affiliation:** PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China

Exploration and Development Research Institute, PetroChina Tarim Oilfield Company, Korla; Xinjiang; 841000, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 1

**Issue date:** January 25, 2020

**Publication year:** 2020

**Pages:** 11-19

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** The Bozi-Dabei Block in the west of the Kelasu tectonic zone in the Tarim Basin is a complex tectonic zone which is characterized by ultra depth, high temperature, ultra high pressure, violent structural deformation and low oil and gas exploration degree. In Well Bozi 9 which is a wildcat well drilled in the Bozi-Dabei Block, a breakthrough has been made recently with a high-yield

industrial oil and gas flow produced during a fracturing test. In order to speed up the oil and gas exploration in this block, this paper analyzed the controlling effect of fault grading combination and paleo-structure on structural deformation in the Kelasu tectonic zone. Then, provenance, stress field and hydrocarbon accumulation characteristics of Bashijiqike Formation and Baxigai Formation of Lower Cretaceous were investigated. Finally, the natural gas exploration potential was evaluated. And the following research results were obtained. First, there are four first-order faults in the Kelasu tectonic zone, including Bozi-Kela, Kelasu, Keshen and Baicheng, which form and control four fault tectonic belts. Second, in the west of this tectonic zone develop two paleo-structures (Bozi and Dabei), which began in the Early Cretaceous and five structural models are formed. Third, two sets of sandstone reservoirs of Bashijiqike Formation and Baxigai Formation are developed in the Kelasu tectonic zone. The former is an ultra-deep (7 500 m) quality reservoir, which is under the control of coarse lithology, weak compaction and low stress. The latter is mainly located in the second member and classified as a fractured-porous reservoir of braided river delta front. Fourth, the crude oil in the west of the Kelasu tectonic zone is originated from the source rocks of the Qiakemake Formation of Middle Jurassic, and it underwent two stages of hydrocarbon accumulation, i.e., "oil accumulation in the early stage of and gas accumulation in the late stage". The dry gas in the east is mainly derived from the source rocks of the Huangshanjie Formation of Upper Triassic in the pattern of one-stage hydrocarbon accumulation. In this way, the hydrocarbon accumulation characteristics of dry gas in the east and condensate gas in the west are formed. In conclusion, a favorable trap with natural gas resources of more than a trillion cubic meters is developed in the Bozi-Dabei Block, a series of gas reservoirs with resources of hundreds of billions cubic meters (e.g. Bozi 9) have been discovered and oil and gas breakthroughs have been realized continuously. In addition, the Bozi-Dabei major gas area with resources of one trillion cubic meters will be implemented in the near future.

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**Number of references:** 22

**Main heading:** Discovery wells

**Controlled terms:** Deformation - Energy resources - Faulting - Flow of gases - Gases - Geological surveys - Grading - Hydrocarbons - Lithology - Natural gas - Natural gas wells - Oil well drilling - Oil well testing - Petroleum prospecting - Petroleum reservoirs - Quality control - Reservoirs (water) - Wildcat wells

**Uncontrolled terms:** Bozi-Dabei Block - Early Cretaceous - Natural-gas accumulation - Tarim Basin - Trap - Ultra deeps

**Classification** 441.2 Reservoirs - 481.1 Geology - 484.1 Earthquake

**code:** Measurements and Analysis - 511.1 Oil Field Production Operations - 512 Petroleum and Related Deposits - 522 Gas Fuels - 525.1 Energy Resources and Renewable Energy Issues - 631.1.2 Gas Dynamics - 804.1 Organic Compounds - 913.3 Quality Assurance and Control

**Numerical data indexing:** Size 7.50e+03m

**DOI:** 10.3787/j.issn.1000-0976.2020.01.002

**Database:** Compendex

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78.

**Accession number:** 20201708556848

**Title:** Simulation of fracture propagation and optimization of ball-sealer in-stage diversion under the effect of heterogeneous stress field

**Title of translation:** 非均匀应力场影响下的裂缝扩展模拟及投球暂堵优化

**Authors:** Zhou, Tong ; Chen, Ming ; Zhang, Shicheng ; Li, Yuanzhao ; Li, Fengxia ; Zhang, Chi

**Author affiliation:** Sinopec Petroleum Exploration and Production Development Research Institute, Beijing; 100083, China  
China University of Petroleum, Beijing, Beijing; 102249, China  
Sinopec Chongqing Fuling Shale Gas Exploration and Development Co., Ltd., Chongqing; 408014, China

**Source title:** Natural Gas Industry

**Abbreviated source title:** Natur. Gas Ind.

**Volume:** 40

**Issue:** 3

**Issue date:** March 25, 2020

**Publication year:** 2020

**Pages:** 82-91

**Language:** Chinese

**ISSN:** 10000976

**CODEN:** TIGOE3

**Document type:** Journal article (JA)

**Publisher:** Natural Gas Industry Journal Agency

**Abstract:** Ball-sealer in-stage diversion in horizontal wells is a key technique to realize the uniform stimulation of fractured sections in tight oil

and gas reservoirs. So far, however, there are fewer research results on the propagation morphologies of multi-cluster fractures after the implementation of different ball-sealer in-stage diversion processes during the fracturing treatment, which results in less theoretical support for the preparation of field ball-sealer in-stage diversion process and measures and impacts its application effects in the fracturing field. To deal with this situation, this paper established a fully coupled "wellbore-perforation-fracture propagation" model of horizontal wells on the basis of the boundary element method. Then, a method for calculating the allocation of ball sealers was proposed. Finally, the number of ball sealers, diversion time and number of diversions during the intra-stage temporary plugging and diversion under the condition of initial heterogeneous stress field and their effects on the propagation of multi-cluster fractures were simulated. And the following research results were obtained. First, the flow restriction of perforation friction can counterbalance the intake difference caused by the induced stress interference so that the friction difference applied on the fluid flow in each fracture cluster is reduced. Second, when the effect of the heterogeneous distribution of the initial stress field is taken into consideration, the liquid intake of each fracture cluster changes greatly and even ineffective perforation clusters without liquid incoming appear in the high-stress region. And after the ball is injected, new fractures are initiated from the ineffective perforation clusters. Third, when the initial minimum horizontal principal stress difference ( $\Delta\sigma_h$ ) is higher than 3 MPa, it is beneficial to reduce the non-uniform propagation of each fracture cluster by increasing the number of ball sealers appropriately in the middle stage of the construction (over half of the total perforations of each stage) or carrying out temporary plugging in the early-middle stage (including ball injection in batches in the early-middle stage). Fourth, when  $\Delta\sigma_h$  is lower than 2 MPa, it is necessary to reduce the number of ball sealers or inject balls in the middle-late stage, or the non-uniform propagation of each fracture cluster will be aggravated.

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**Number of references:** 24

**Main heading:** Fracture

**Controlled terms:** Boundary element method - Flow control - Flow of fluids - Friction - Horizontal wells - Oil wells - Petroleum reservoir engineering - Petroleum reservoirs - Sailing vessels - Stresses - Well perforation - Well stimulation

**Uncontrolled terms:** Fracture propagation - Fracturing treatments - Heterogeneous distributions - Initial stress field - ITS applications - Principal stress - Research results - Tight oil and gas reservoirs

**Classification code:** 512.1.1 Oil Fields - 512.1.2 Petroleum Deposits : Development Operations - 631.1 Fluid Flow, General - 674.1 Small Marine Craft - 921.6 Numerical Methods - 951 Materials Science

**Numerical data indexing:** Pressure 2.00e+06Pa, Pressure 3.00e+06Pa

**DOI:** 10.3787/j.issn.1000-0976.2020.03.010

**Database:** Compendex

Compilation and indexing terms, © 2020 Elsevier Inc.

79.

**Accession number:** 20202008670876

**Title:** **Petroleum, petrochemical and natural gas industries — Bulk material for offshore projects — Pipe support**

**Source title:** Petroleum, petrochemical and natural gas industries — Bulk material for offshore projects — Pipe support

**Standard designation:** 20/30408276 DC

**Standard ID:** 20/30408276 DC

**Issue date:** May 5, 2020

**Publication year:** 2020

**Pages:** 1-62

**Language:** English

**Publisher:** BSI Standards Limited

**Abstract:** Scope: This document specifies the requirements for design including shape and dimensions, material as well as strength for pipe support from NPS 2 up to NPS 36 except for U-bolt and U-strap. This document covers topside systems for fixed or floating offshore oil and gas projects. This document applies for design temperature of support within the range between -23 °C up to 200 °C. This document is limited to metallic pipes only. This document covers such requirements for following pipe supports: — clamped shoe; — welded shoe; — U-bolt; — U-strap; — bracing for branch connection; — trunnion and stanchion; — guide support(guide, hold-down, guide/hold-down). This document addresses design requirements of the listed items above, hence the document does not necessarily cover all other types of pipe supports.

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**Abstract type:** (Edited Abstract)

**Number of references:** 17

**Main heading:** Offshore pipelines

**Controlled terms:** Bolts - Gas industry - Offshore oil well production - Offshore oil wells

**Uncontrolled** Branch connections - Bulk materials - Design temperature -

**terms:** Hold-downs - Metallic pipes - Offshore oil - Offshore project  
**Classification** 511.1 Oil Field Production Operations - 511.2 Oil Field Equipment  
**code:** - 512.1.1 Oil Fields - 522 Gas Fuels - 605 Small Tools and Hardware  
**Numerical data** Temperature 4.73e+02K  
**indexing:**  
**Versions:** 1  
**Status:** Active - Definitive  
**Standard website** <https://shop.bsigroup.com/en/ProductDetail/?url=000000000030408276>  
**Database:** Compendex  
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80.

**Accession number:** 20201408376643  
**Title:** **Petroleum and natural gas industries. Arctic operations. Escape, evacuation and rescue from offshore installations**  
**Source title:** Petroleum and natural gas industries. Arctic operations. Escape, evacuation and rescue from offshore installations  
**Standard designation:** BS ISO 35102  
**Standard ID:** BS ISO 35102:2020  
**Issue date:** March 26, 2020  
**Publication year:** 2020  
**Pages:** 1-116  
**Language:** English  
**ISBN-13:** 9780539007404  
**Publisher:** BSI Standards Limited  
**Abstract:** Scope: This document establishes the principles, specifies the requirements and provides guidance for the development and implementation of an escape, evacuation and rescue (EER) plan. It is applicable to offshore installation design, construction, transportation, installation, offshore production/exploration drilling operation service life inspection/repair, decommissioning and removal activities related to petroleum and natural gas industries in the arctic and cold regions. Reference to arctic and cold regions in this document is deemed to include both the Arctic and other locations characterized by low ambient temperatures and the presence or possibility of sea ice, icebergs, icing conditions, persistent snow cover and/or permafrost. This document contains requirements for the design, operation, maintenance, and service-life inspection or repair of new

installations and structures, and to modification of existing installations for operation in the offshore Arctic and cold regions, where ice can be present for at least a portion of the year. This includes offshore exploration, production and accommodation units utilized for such activities. To a limited extent, this document also addresses the vessels that support ER, if part of the overall EER plan. While this document does not apply specifically to mobile offshore drilling units (MODUs, see ISO 19905-1) many of the EER provisions contained herein are applicable to the assessment of such units in situations when the MODU is operated in arctic and cold regions. The provisions of this document are intended to be used by stakeholders including designers, operators and duty holders. In some cases, floating platforms (as a type of offshore installations) can be classified as vessels (ships) by national law and the EER for these units are stipulated by international maritime law. However, many of the EER provisions contained in this document are applicable to such floating platforms. This document applies to mechanical, process and electrical equipment or any specialized process equipment associated with offshore arctic and cold region operations that impacts the performance of the EER system. This includes periodic training and drills, EER system maintenance and precautionary down-manning as well as emergency situations. EER associated with onshore arctic oil and gas facilities are not addressed in this document, except where relevant to an offshore development.

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**Abstract type:** (Edited Abstract)

**Number of references:** 71

**Main heading:** Mobile offshore drilling units

**Controlled terms:** Floating breakwaters - Floating liquefied natural gas - Gas industry - Gases - Gasoline - Infill drilling - Installation - Liquefied natural gas - Natural gas transportation - Offshore drilling - Offshore oil well production - Offshore oil wells - Petroleum industry - Petroleum transportation - Sea ice - Service industry - Snow

**Uncontrolled terms:** BRT Code Arctic - Electrical equipment - Emergency situation - Low ambient temperatures - Offshore development - Offshore exploration - Offshore installations - Offshore production

**Classification code:** 407.1 Maritime Structures - 443.3 Precipitation - 471.1 Oceanography, General - 511.1 Oil Field Production Operations - 511.2 Oil Field Equipment - 512.1.1 Oil Fields - 512.2.1 Natural Gas Fields - 522 Gas Fuels - 523 Liquid Fuels

**Versions:** 1

**Status:** Active - Definitive

**Standard website:** <https://shop.bsigroup.com/en/ProductDetail/?>

**url:** pid=00000000030376731

**Database:** Compendex

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81.

**Accession** 20201508403717

**number:**

**Title:** **Petroleum, petrochemical and natural gas industries - Safety of machineries - Powered elevators (ISO 20321:2020)**

**Title of translation:** **Industries du pétrole, de la pétrochimie et du gaz naturel - Sécurité des machines - élévateurs motorisés (ISO 20321:2020)**

**Source title:** Petroleum, petrochemical and natural gas industries - Safety of machineries - Powered elevators (ISO 20321:2020)

**Standard designation:** BS EN ISO 20321

**Standard ID:** BS EN ISO 20321:2020

**Issue date:** March 30, 2020

**Publication year:** 2020

**Pages:** 1-34

**Language:** English

**ISBN-13:** 9780580892721

**Publisher:** BSI Standards Limited

**Abstract:** This document specifies general safety requirements for the design, testing and production of powered elevators. The requirements are applicable for onshore and offshore applications of such elevators in the petroleum and petrochemical industries. This document does not cover any other type of elevator. It is not applicable to the following types of products: remote control devices; lifting nubbins; lifting plugs; lifting subs; internal gripping devices; equipment for lifting tubular from and onto a vessel; elevator links or bails. This list is not exhaustive. This document is not applicable to powered elevators manufactured before the date of this publication. NOTE Annex AA provides the relation between the clauses of the European Directive on machinery (Directive 2006/42/EC) and this document, for potential significant hazards and the safety requirements dealing with them for powered elevators.  
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**Abstract type:** (Edited Abstract)

**Number of references:** 5

**Main heading:** Accident prevention

**Controlled terms:** Accidents - Elevators - Ergonomics - Exploratory oil well

drilling - Gas industry - Gasoline - Occupational risks -  
Offshore oil well production - Petrochemicals - Petroleum  
industry - Remote control - Safety testing

**Uncontrolled terms:** BRT Code Anthropometric characteristics - BRT Code Crushing (accident) - BRT Code Zones of reach - Code safety - Equipment safety - Human bodies - Occupational safety

**Classification code:** 511.1 Oil Field Production Operations - 513.3 Petroleum Products - 522 Gas Fuels - 523 Liquid Fuels - 692.2 Elevators - 731.1 Control Systems - 914.1 Accidents and Accident Prevention

**Versions:** 1

**Status:** Active - Definitive

**Standard website url:** <https://shop.bsigroup.com/en/ProductDetail/?pid=00000000030318780>

**Database:** Compendex

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82.

**Accession number:** 20201508403750

**Title:** **Petroleum and natural gas industries - specific requirements for offshore structures - part 5: Weight management**

**Source title:** Petroleum and natural gas industries - specific requirements for offshore structures - part 5: Weight management

**Standard designation:** 20/30363865 DC

**Standard ID:** 20/30363865 DC

**Issue date:** March 23, 2020

**Publication year:** 2020

**Pages:** 1-76

**Language:** English

**Publisher:** BSI Standards Limited

**Abstract:** This document specifies requirements for managing and controlling the weight and centre of gravity (CoG) of offshore facilities by means of mass management during all lifecycle phases; including conceptual design, front end engineering, detail engineering, onshore/inshore construction, and offshore installation. These facilities can be completely new installations (Greenfield) or the modifications to existing installations (Brownfield). It is also necessary to continue managing and controlling weight throughout operations, decommissioning and removal to facilitate Structural Integrity Management (SIM) and to assist with removal of facilities during decommissioning. The provisions are applicable to offshore facilities of all types (fixed and floating). Only items with mass shall be addressed. Loads not

related to mass shall be omitted. Se ISO 19904-1, ISO 19901-6 and ISO 19901-7. Weights from mass of snow and ice are not to be included as they are not part of a facility. This document specifies: managing and controlling weights and CoGs for components and entire facilities; managing weight and CoG interfaces; standardised terminology for weight and CoG estimating and reporting; requirements for determining Not To Exceed (NTE) weights and budget weights; weighing and determination of weight and CoG of tagged equipment, major assemblies, modules and facilities; This document can be used as a basis for: costing, scheduling or determining suitable construction method(s) or location(s); planning, evaluating and presenting the client' s, contractor' s or fabricator' s weight management and reporting system; as a contract reference between client, contractor and suppliers; as a means of refining the structural analysis or model.  
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**Abstract type:** (Edited Abstract)

**Number of references:** 13

**Main heading:** Gas industry

**Controlled terms:** Budget control - Conceptual design - Construction equipment - Contractors - Decommissioning (nuclear reactors) - Durability - Environmental testing - Exploratory oil well drilling - Extraction - Gasoline - Gravitation - Life cycle - Natural gas - Offshore oil well production - Offshore structures - Petroleum industry - Scheduling - Structural design

**Uncontrolled terms:** BRT Code Industrial - BRT Code Vibration - Code classification - Code inspections - Fitness for purpose - Natural gas extraction - Offshore constructions - Petroleum extraction

**Classification code:** 405.1 Construction Equipment - 408.1 Structural Design, General - 511.1 Oil Field Production Operations - 522 Gas Fuels - 523 Liquid Fuels - 621 Nuclear Reactors - 674.2 Marine Drilling Rigs and Platforms - 802.3 Chemical Operations - 912 Industrial Engineering and Management - 912.2 Management - 931.5 Gravitation, Relativity and String Theory

**Versions:** 1

**Status:** Active - Definitive

**Standard website url:** <https://shop.bsigroup.com/en/ProductDetail/?pid=000000000030363865>

**Database:** Compendex

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**number:**

**Title:** Petroleum, petrochemical and natural gas industries - Sector-specific quality management systems - Requirements for product and service supply organizations (ISO 29001:2020)

**Title of translation:** Industries du pétrole, de la pétrochimie et du gaz naturel - Systèmes de management de la qualité spécifiques au secteur - Exigences pour les organismes de fourniture de produits et de services (ISO 29001:2020)

**Source title:** Petroleum, petrochemical and natural gas industries - Sector-specific quality management systems - Requirements for product and service supply organizations (ISO 29001:2020)

**Standard designation:** BS EN ISO 29001

**Standard ID:** BS EN ISO 29001:2020

**Issue date:** May 27, 2020

**Publication year:** 2020

**Pages:** 1-68

**Language:** English

**ISBN-13:** 978 0 580 98062 6

**Publisher:** BSI Standards Limited

**Abstract:** Scope: This International Standard specifies requirements for a quality management system when an organization: a) needs to demonstrate its ability to consistently provide products and services that meet customer and applicable statutory and regulatory requirements, and b) aims to enhance customer satisfaction through the effective application of the system, including processes for improvement of the system and the assurance of conformity to customer and applicable statutory and regulatory requirements. All the requirements of this International Standard are generic and are intended to be applicable to any organization, regardless of its type or size, or the products and services it provides. NOTE 1 In this International Standard, the terms "product" or "service" only apply to products and services intended for, or required by, a customer. NOTE 2 Statutory and regulatory requirements can be expressed as legal requirements. This document defines quality management system requirements for product and service supply organizations to the petroleum, petrochemical and natural gas industries. This document is written as a supplement to ISO 9001:2015. The supplementary requirements and guidance to ISO 9001:2015 have been developed to manage supply chain risks and opportunities associated with the petroleum, petrochemical and natural gas industries and to provide a framework for aligning requirements with complementary standards employed within the industries.

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**Abstract type:** (Edited Abstract)

**Number of references:** 52

**Main heading:** Service industry

**Controlled terms:** Customer satisfaction - Gas industry - Gasoline - Natural gas - Petrochemicals - Quality management - Requirements engineering - Sales - Supply chains

**Uncontrolled terms:** International standards - ISO 9001 - Product and services - Products and services - Quality management systems - Regulatory requirements - Supply chain risk

**Classification code:** 513.3 Petroleum Products - 522 Gas Fuels - 523 Liquid Fuels - 912 Industrial Engineering and Management - 912.2 Management - 913 Production Planning and Control; Manufacturing

**Versions:** 1

**Status:** Active - Definitive

**Standard website url:** <https://shop.bsigroup.com/en/ProductDetail/?pid=000000000030358589>

**Database:** Compendex

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84.

**Accession number:** 20202908943140

**Title:** **Petroleum, petrochemical and natural gas industries - External corrosion protection of risers by coatings and linings. Part 2: Maintenance and field repair coatings for riser pipes**

**Title of translation:** **Industries du pétrole, de la pétrochimie et du gaz naturel — Protection de la corrosion externe des tubes de production par revêtements et doublures — Partie 2: Partie 2: Entretien et réparation in situ des tubes de production**

**Source title:** Petroleum, petrochemical and natural gas industries - External corrosion protection of risers by coatings and linings. Part 2: Maintenance and field repair coatings for riser pipes

**Standard designation:** 20/30414590 DC

**Standard ID:** 20/30414590 DC

**Issue date:** July 3, 2020

**Publication year:** 2020

**Pages:** 1-66

**Language:** English

**Publisher:** BSI Standards Limited

**Abstract:** Scope: This document specifies the selection criteria and

minimum requirements for protective coating systems for field maintenance and repair of risers exposed to conditions in the splash zone. This document does not cover the selection of techniques and materials used to restore integrity of the risers to be coated. This document neither covers the selection of additional mechanical protective materials that are not part of the described coating systems included in this document. This document is applicable for maintenance requirements and field repairs of risers. New construction riser coatings and repair of damaged applied coatings before installation are covered in ISO 18797-1.

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**Abstract type:** (Edited Abstract)

**Number of references:** 9

**Main heading:** Repair

**Controlled terms:** Corrosion resistant coatings - Gas industry - Linings

**Uncontrolled terms:** Coating system - Maintenance requirement - Minimum requirements - New constructions - Protective materials - Riser pipes - Selection criteria - Splash zone

**Classification code:** 522 Gas Fuels - 913.5 Maintenance - 951 Materials Science

**Versions:** 1

**Status:** Active - Definitive

**Standard website url:** <https://shop.bsigroup.com/en/ProductDetail/?pid=000000000030414590>

**Database:** Compendex

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85.

**Accession number:** 20202708887636

**Title:** **Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems. Part 3: Field joint coatings (ISO 21809-3:2016)**

**Title of translation:** **Industries du pétrole et du gaz naturel - Revêtements externes des conduites enterrées ou immergées utilisées dans les systèmes de transport par conduites - Partie 3: Revêtements des joints soudés sur site (ISO 21809-3:2016)**

**Source title:** Petroleum and natural gas industries - External coatings for buried or submerged pipelines used in pipeline transportation systems. Part 3: Field joint coatings (ISO 21809-3:2016)

**Standard designation:** BS EN ISO 21809-3

**Standard ID:** BS EN ISO 21809-3:2016+A1:2020

**Issue date:** May 13, 2020

**Publication year:** 2020

**Pages:** 1-136

**Language:** English

**ISBN-13:** 9780580986390

**Publisher:** BSI Standards Limited

**Abstract:** Scope: This part of ISO 21809 specifies requirements for field joint coating of seamless or welded steel pipes for buried and submerged sections of pipeline transportation systems used in the petroleum, petrochemical and natural gas industries as defined in ISO 13623. This part of ISO 21809 specifies the qualification, application and testing of the corrosion protection coatings applied to steel surfaces left bare after the joining of pipes and fittings (components) by welding. This part of ISO 21809 defines and codifies in Table 1 the different types of field joint coatings for pipelines. This part of ISO 21809 does not address requirements for additional mechanical protection, for thermal insulation or for joint infills of concrete weight-coated pipes. NOTE Field joints of pipes and fittings coated in accordance with this part of ISO 21809 are considered suitable for further protection by means of cathodic protection.

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**Abstract type:** (Edited Abstract)

**Number of references:** 11

**Main heading:** Corrosion resistant coatings

**Controlled terms:** Cathodic protection - Concrete pipe - Erbium - Fits and tolerances - Gas industry - Gasoline - Natural gas - Natural gas fields - Natural gas transportation - Petroleum industry - Petroleum transportation - Pipe fittings - Pipeline corrosion - Pipeline terminals - Pipelines - Steel corrosion - Thermal insulation - Welding - Welding codes

**Uncontrolled terms:** Joining of pipes - Joint coatings - Mechanical protection - Pipe-line transportations - Steel surface - Welded steels

**Classification code:** 413.2 Heat Insulating Materials - 512.2.1 Natural Gas Fields - 522 Gas Fuels - 523 Liquid Fuels - 538.2 Welding - 539.1 Metals Corrosion - 539.2 Corrosion Protection - 547.2 Rare Earth Metals - 619.1 Pipe, Piping and Pipelines - 619.1.1 Pipe Accessories

**Versions:** 2

**Status:** Active - Definitive

**Standard website url:** <https://shop.bsigroup.com/en/ProductDetail/?pid=000000000030361123>

**Database:** Compendex

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86.

**Accession number:** 20202708895833

**Title:** **Petroleum and natural gas industries - Corrosion-resistant alloy seamless tubular products for use as casing, tubing, coupling stock and accessory material - Technical delivery conditions (ISO 13680:2020)**

**Title of translation:** **Industries du pétrole et du gaz naturel - Produits tubulaires sans soudure en acier allié résistant à la corrosion utilisés comme tubes de cuvelage, tubes de production, tubes-ébauches pour manchons et matériau pour accessoires - Conditions techniques de livraison (ISO 13680:2020)**

**Source title:** Petroleum and natural gas industries - Corrosion-resistant alloy seamless tubular products for use as casing, tubing, coupling stock and accessory material - Technical delivery conditions (ISO 13680:2020)

**Standard designation:** BS EN ISO 13680

**Standard ID:** BS EN ISO 13680:2020

**Issue date:** June 9, 2020

**Publication year:** 2020

**Pages:** 1-136

**Language:** English

**ISBN-13:** 9780539034035

**Publisher:** BSI Standards Limited

**Abstract:** Scope: This document specifies the technical delivery conditions for corrosion-resistant alloy seamless tubular products for casing, tubing, coupling stock and accessory material (including coupling stock and accessory material from bar) for two product specification levels: — PSL-1, which is the basis of this document; — PSL-2, which provides additional requirements for a product that is intended to be both corrosion and cracking resistant for the environments and qualification method specified in Annex G and in the ISO 15156 series. At the option of the manufacturer, PSL-2 products can be provided in lieu of PSL-1. NOTE 1 The corrosion-resistant alloys included in this document are special alloys in accordance with ISO 4948-1 and ISO 4948-2. NOTE 2 For the purpose of this document, NACE MR0175 is equivalent to the ISO 15156 series. NOTE 3 Accessory products can be manufactured from coupling stock and tubular material, or from solid bar stock or from bored and heat-treated bar stock as covered in Annex F. This document contains no provisions relating to the connection of individual lengths of pipe. This document contains provisions relating to marking of tubing and

casing after threading. This document is applicable to the following five groups of products: a) group 1, which is composed of stainless alloys with a martensitic or martensitic/ferritic structure; b) group 2, which is composed of stainless alloys with a ferritic-austenitic structure, such as duplex and super-duplex stainless alloy; c) group 3, which is composed of stainless alloys with an austenitic structure (iron base); d) group 4, which is composed of nickel-based alloys with an austenitic structure (nickel base); e) group 5, which is composed of bar only (Annex F) in age-hardened (AH) nickel-based alloys with austenitic structure. NOTE 4 Not all PSL-1 categories and grades can be made cracking resistant in accordance with the ISO 15156 series and are, therefore, not included in PSL-2.  
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**Abstract type:** (Edited Abstract)

**Number of references:** 17

**Main heading:** Corrosion resistant alloys

**Controlled terms:** Austenite - Corrosion resistance - Duplex stainless steel - Gas industry - Martensite - Nickel alloys - Petroleum industry - Tubing

**Uncontrolled terms:** Accessory materials - Accessory products - Austenitic structure - Nickel based alloy - Stainless alloys - Super duplex stainless - Tubular materials - Tubular products

**Classification code:** 522 Gas Fuels - 531.2 Metallography - 539.1 Metals Corrosion - 548.2 Nickel Alloys - 619.1 Pipe, Piping and Pipelines

**Versions:** 4

**Status:** Active - Definitive

**Standard website url:** <https://shop.bsigroup.com/en/ProductDetail/?pid=000000000030389000>

**Database:** Compendex

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