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The Geochemical Properties and Provenance of Ordovician Ultra-deep Natural Gas

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Abstract

Ultra-deep Ordovician period in Shuntuoguole space, Tarim Basin, NW China, has advanced oil & gas phases, during which light-weight oil, oil, atmospheric phenomenon and dry gas phases coexistent. The study compares the geochemical characteristics and origin of Ordovician period ultra-deep gas within the North Shuntuoguole (SB) space to it of gas within the Shuntuo (ST), South Shuntuoguole (SN), Gulong (GL), and Gucheng (GC) areas mistreatment gas composition, carbon atom and chemical element atom information and light-weight organic compound information. The Ordovician period ultra-deep gas within the SB space is wet gas, with waterlessness indexes starting from 0.52 to 0.88 and negligible H2S content. The carbon isotopes of gas area unit comparatively low, with δ13C1 and δ13C2 values starting from -49.6‰ to -44.7‰ and-39.3‰ to -32.7‰, severally. All the gas shows positive carbon and chemical element atom series. The n-alkane and iso-alkane dominate the C5–C7 light-weight organic compound, with the methylcyclohexane index of sunshine organic compound not up to thirty fifth. All of the Ordovician period gas within the Shuntuogule space is oil-type gas. The Ordovician period gas within the SB space is dominated by kerogen cracking gas, with a little fraction of wet gas from the first stages of oil cracking, whereas, all of the gas within the ST, SN, GL and GHz areas comes from oil cracking. The Cambrian supply rocks diode on to each styles of cracking gases. The distribution of 2 styles of cracking gas within the Shuntuogule space is related to with the utmost paleogeothermal temperature and (or) gift temperature of the Ordovician period.

Keywords: Natural gas; Ordovician; Oil-type gas; Ultra-deep; North Shuntuoguole (SB) space; Tarim Basin

Introduction

The Ordovician period fossil fuel exploration within the Shuntuoguole space of the Tarim Basin began in 2011 with the invention of oil & gas within the Yijianfang Formation (O2yj) of Well SN1. Wells SN4 and SN5 within the Yingshan Formation (O1-2y) achieved high-yield gas flow. Well ST1, settled northwest of Well SN1, obtained a high-yield atmospheric phenomenon oil & gas flow within the O2yj and prime of O1-2y Formations [1] Well SB1 obtained a low-yield oil & gas flow, whereas Well SB1–1H was deviated and obtained high production of oil. moreover, the invention of the North Shuntuoguole (SB) field (also named Shunbei field in literature) was proclaimed once six analysis wells achieved high production. In March 2020, Well Manshen1 (MS1) of Petro China Tarim field Company, settled within the northern a part of the No.4 fault (F4) within the SB space, achieved a breakthrough, with daily production of 624 money supply and daily gas production of 371.3×10^3 money supply employing a 10 millimeter nozzle. The reservoir fluid phases of Ordovician period within the Shuntuoguole space area unit advanced, with light-weight oil, oil, atmospheric phenomenon and dry gas phases coexistent. in step with previous studies, the marine strata within the Tarim platform embody 2 styles of natural gas: mature-high mature wet gas from Ordovician period supply rocks and over mature dry gas from Cambrian supply rocks. High mature-over mature gas will be any divided into kerogen-cracking gas and oil-cracking gas. supported dry gas and δ13C1 bigger than -42.5‰, Wang planned that gas from the South Shuntuoguole (SN) and Gucheng (GC) areas originated from Cambrian supply rocks and fashioned within the late Himlaya amount kerogen-cracking gas would possibly dominate gas within the metal space. The Ordovician period gas within the metal and GHz areas. the ultra-deep Ordovician period gas within the SB space is wet gas, with kerogen-cracking gas dominating and half samples mixed with oil-cracking gas from the first stage of oil cracking [2-3].

Chemical composition of gas

SCION-456 gas natural process was wont to verify the chemical composition of gas. The organic compound gas detector was associate degree FID. For organic compound gas, the Al2O3 PLOT column (50m × 0.53 mm) was used. The GHz kitchen appliance temperature was at the start set at 32°C for 15min, then step by step enlarged to 180°C at 1.5 °C/min. Meanwhile, the appliance and detector temperatures were 140°C and 240°C, severally. N was used as a carrier gas. TCD was wont to sight the non-hydrocarbon gas. The temperatures of the appliance and detector were 140°C and 300°C, severally. For greenhouse emission analysis, a PorparKQ column (2m × 3mm) was used whereas argonon was used because the carrier gas. The GHz column temperature was raised at a rate of 20°C/min from 40°C to 100°C. For the remaining non-hydrocarbon gases, a TDX column (2m × 3mm) was used, with the column temperature programmed from 32°C to a hundred and 20°C at a rate 20°C/min [4-5].

Light organic compound of gas

An H.P. Agilent 6890 N gas natural process associate degreed an HP-PONA column (50m × 0.20mm × 0.30 μm) were wont to analyze light-weight organic compound in gas. The GHz kitchen appliance temperature was at the start set to 35°C for fifteen min, then enlarged to 70°C at 1.5 °C/min, then programmed to 130°C at 2.5 °C/min, enlarged

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to 310 °C at the speed of 5°C/min, and control for 25min. A flame particle detector (FID) was utilized in the experiment. N was used as a carrier gas, whereas appliance and detector temperatures were set to 200°C and 320 °C, severally [6].

Carbon atom composition of gas

An MAT 253 stable atom prism spectroscope was utilized in conjunction with a PoraparaK alphabetic character column to work out the carbon atom composition of gas. The GHz kitchen appliance temperature was at the start set at 32°C for five min, then enlarged to 135°C at a rate of 5°C/min, then programmed at 15°C/min to 190°C, enlarged to 230°C at the speed of 20°C/min and control for 5min. The column flow was 1.8 mL/min whereas the appliance temperature was set at a hundred and 50°C. The carbon atom analysis accuracy was ±0.5‰ mistreatment the international customary PDB carbon atom as a customary [7-8].

Chemical element atom composition of gas

The chemical element atom composition was conducted by DELTA V Advantage stable atom prism spectroscope (GC/TC/IRMS) with associate degree HP5 MS capillary column (30m × 0.20mm × 0.32 μm). The GHz kitchen appliance temperature was at the start set at 35°C for 4min, then enlarged to 90°C at a rate of 5°C/min and unbroken for 2min. it had been then programmed at a rate of 10°C/min to 100°C and 50°C, enlarged to 230 °C at a rate of 20°C/min, and control for 3min. The split quantitative relation was 1:20 whereas the column flow was 1.0 mL/min. The temperature of the transmutation kitchen appliance was set to 1400 °C. The chemical element atom accuracy is three-dimensional, with VSMOW because the customary [9-11].

Gentic origin and supply of gas

The carbon and chemical element atom distributions of Ordovician period gas within the SB space area unit each positive series distributions, implying that each one the gas within the space is of organic origin. All of the gas within the SB space belongs to thermogenic gases. Within the diagram of carbon and chemical element isotopes, the Ordovician period gas within the SB space is organic-origin gas. The carbon atom price of hydrocarbon will be wont to classify gas sort. In China, the δ13C2 price of -29‰ or -28‰ is usually differentiates between oil-type gas and coal-type gas. The δ13C2 values of Ordovician period within the SB space area unit all lighter than -32‰, indicating that each one of the Ordovician period gas within the SB space is oil-type gas. As shown within the diagram of δ13C1-δ13C2 the Ordovician period gas within the SB space is analogous to the gas generated from sort II kerogen within the Delware/Val Verde Basin [12-13].

Conclusion

The Ordovician period ultra-deep gas within the SB space is dominated by n-alkane gas and typical wet gas, with a waterlessness constant starting from 0.47 to 0.88. The foremost common non-hydrocarbon gases area unit greenhouse emission and N2, with H2S being a minor part. The gas within the SB space has positive carbon and chemical element atom series distribution. The Ordovician period gas within the SB space is all oil-type gas, dominated by kerogen-cracking gas, and a little share of early-stage oil-cracking gas mixed in. The gas within the ST, SN, GL and GHz areas, on the opposite hand, is oil-cracking gas. Gas from the SB, ST, SN, GL and GHz areas could come back from constant Cambrian supply rock. The H2S content of gas from the SB space is low, suggesting a weak TSR. The H2S originates from the thermal cracking of sulfur-containing compounds. The distribution of 2 styles of Ordovician period ultra-deep cracking gas within the Shuntuoguole space is indivisible from the temperature seasoned by the Ordovician period. The utmost paleo-geothermal and gift temperatures seasoned by the Ordovician period T74 boundary within the SB space area unit within vary of 170–180°C and 150–160°C, severally, below the destruction temperature of the separate oil part. Therefore, light-weight oil and oil phases will be preserved within the SB space, what is more gas is especially kerogen-cracking gas. However, the utmost paleo-geothermal temperature seasoned by the Ordovician period from the ST, SN, GL and GHz areas throughout earth science history exceeded 180°C, and also the most gift temperature of the Ordovician period is close to 200°C. Thanks to the massive scale of the paleo-reservoir, solely the atmospheric phenomenon oil and dry gas phases will be preserved [14-15].

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