**Table 1 X-ray diffraction analysis results of black shale. TOC: total organic carbon.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Shale samples* |  | | *Mineral type and content* (%) | | | | | | *Clay mineral content fraction* (%) | *Relative content of clay minerals* (%) | | | |
| *Ro* (%) | *TOC* (%) | *Quartz* | *Potash feldspar* | *Albite* | *Calcite* | *Dolomite* | *Pyrite* | *Imon mixed layer* | *Illite* | *Kaolinite* | *Chlorite* |
| FS-1 | 2.270 | 3.94 | 27.4 | - | 18.4 | - | 5.8 | 5.8 | 42.6 | - | 100 | - | - |
| FS-2 | 2.260 | 5.01 | 47.2 | 2.8 | 23.9 | - | - | 9.1 | 17 | - | 100 | - | - |
| TM-2 | 3.112 | 5.05 | 38.6 | 1.8 | 12.7 | - | 4.3 | 14.7 | 27.9 | - | 99 | 1 | - |
| TM-3 | 1.352 | 4.25 | 72.8 | 1.0 | 5.3 | 4.8 | 2.6 | 4.6 | 8.9 | - | 100 | - | - |
| DF-2 | 2.444 | 7.50 | 39.6 | - | 15.2 | - | 7.7 | 9.3 | 28.2 | 8.9 | 81 | 8.9 | 1.2 |
| DF-3 | 1.873 | 4.02 | 46.9 | - | 21.9 | - | - | 9.4 | 21.8 | - | 89 | 7.6 | 4.4 |

**Table 2 Porosity nuclear magnetic resonance test results**

|  |  |  |
| --- | --- | --- |
| *Sample* | *Saturated porosity* (%) | *Centrifugal porosity* (%) |
| FS-1 | 1.812 | 1.576 |
| FS-2 | 1.218 | 1.206 |
| TM-2 | 2.103 | 2.063 |
| TM-3 | 1.989 | 1.908 |
| DF-2 | 0.962 | 0.831 |
| DF-3 | 0.637 | 0.589 |

**Table 3 Test results of low-temperature liquid nitrogen adsorption/desorption experiment**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Sample* | *Sampling depth* (m) | *BET specific surface area* (m2/g) | *Average pore size* (nm) | *Total pore volume per unit mass* (cm3) |
| FS-1 | 2461.11 | 12.7904 | 4.2448 | 0.009794 |
| FS-2 | 2518.99 | 7.2327 | 4.0125 | 0.004209 |
| TM-2 | 1487.63 | 20.652 | 3.8732 | 0.010062 |
| TM-3 | 1459.22 | 15.4600 | 4.1239 | 0.007937 |
| DF-2 | 996.14 | 14.1255 | 6.3089 | 0.014542 |
| DF-3 | 1021.27 | 12.1157 | 5.0693 | 0.009675 |

**Table 4 Calculated pore fractal dimension for each sample.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Experimental sample* | *Linear equation* | *Correlation coefficient R2* | *B* | *D* = *B*+3 |
| FS-1 | y = 0.977-0.06597x | 0.96795 | -0.06597 | 2.93 |
| FS-2 | y = 1.58767-0.10283x | 0.91801 | -0.10283 | 2.89 |
| TM-2 | y = 2.01753-0.05228x | 0.99225 | -0.05228 | 2.95 |
| TM-3 | y = 1.74966-0.05917x | 0.98769 | -0.05917 | 2.94 |
| DF-2 | y = 1.66841-0.16369x | 0.99142 | -0.16369 | 2.83 |
| DF-3 | y = 1.51629-0.1078x | 0.99254 | -0.10780 | 2.90 |

**Table 5 Effective diffusion coefficient of Fick diffusion under different fractal dimensions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Fractal dimension* | 2.95 | 2.94 | 2.93 | 2.90 | 2.89 | 2.83 |
| *Fick effective diffusion coefficient* | 1.50× 24-10 | 1.55× 24-10 | 1.60× 24-10 | 1.76× 24-10 | 1.81× 24-10 | 2.20×24-10 |