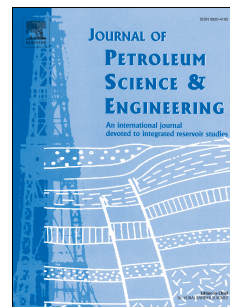


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1 Combining pressure-controlled porosimetry and rate-controlled porosimetry to 2 investigate the fractal characteristics of full-range pores in tight oil reservoirs

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12 Abstract

13 Tight oil reservoirs have the characteristics of wide pore size range and complex
14 pore system. The understanding of pore characteristics is the basis for studying the
15 accumulation and migration of oil and gas. To better study the fractal characteristics
16 of full-range pores in Lucaogou tight oil reservoir, scanning electron microscopy
17 (SEM) and mercury intrusion porosimetry (MIP) were used to obtain the pore size.
18 XRD was used to obtain the mineral composition. In addition, fractal analysis was
19 performed on the samples based on MIP data. The results show fracture pore (FP),
20 residual interparticle pore (RIP), dissolution pore (DP) and clay dominated pore (CDP)
21 are the main pore types. The interparticle pores is commonly largest in size, followed
22 by dissolution pores. Quartz and feldspar play dominant roles in the composition in
23 Lucaogou tight oil reservoir. The full-range pore size distribution (PSD) curves
24 ranged from 3.6 nm to 400 μm with two main distribution intervals. The fractal
25 dimensions (D_1 , D_2 and D_3) reflect the complexity of CDPs, DPs and RIPs,
26 respectively. The average values of fractal dimensions were 2.88, 2.8 and 2.56, the
27 smaller pores have more complex pore system. The pore structure of clay dominated
28 pores is most complex. The more complex the pore structure, the worse the reservoir
29 performance. Quartz shows negative correlation with D_3 , Clay shows positive
30 correlation with D_1 , and feldspar is positively correlated with D_2 . D_1 , D_2 and D_3 are
31 negatively correlated to porosity, D_1 shows a strong negative correlation with
32 permeability.

33 Key words: Tight oil reservoir; Pore size distributions; Fractal characteristics;
34 Mineral composition; Mercury intrusion porosimetry.

35 1. Introduction

36 Fractal theory, which was first proposed by Mandelbrot (1975), is a very popular
37 and active new theory and new discipline. The mathematical basis of fractal theory is
38 fractal geometry, from which fractal information, fractal design, fractal art, and so on
39 are derived (Mandelbrot, 1975). As a mathematical tool, fractal theory has been
40 applied in many fields at present (Cutler, 1993; Cai et al., 2017). The fractal theory is
41 one of the most commonly used methods to describe the natural objects with
42 non-Euclidean shapes (Liu et al., 2018). In the field of geology, it is difficult to
43 describe the pore heterogeneity of underground rocks because of the complexity of
44 the pore system (Wang et al, 2017). Fractal theory can quantitatively characterize

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