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Mechanics Differences of Laminations and Crack Propagation Mechanism of Continental Shale

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ABSTRACT

Clarify the mechanical properties of different laminations and the fracture mechanism of continental shale under in-situ stress can provide theoretical basis for more comprehensive evaluation of the fracability of continental shale oil reservoir. The Chang 7_2 continental shale was used to investigate the mechanical properties of laminations and the effect of natural structure on the crack propagation of the shale. The X-ray diffraction (XRD) and thin section tests show that the laminations contain two types: bright sandy lamination with void structure and dark muddy lamination with layer structure. The real-time Computed Tomography (CT) uniaxial compression tests were conducted to investigate the differences of mechanical properties between the muddy lamination and sandy lamination. It found that the uniaxial compression strength and elastic modulus of the sandy lamination are higher, forming a simple crack with large opening, and the Poisson's ratio of the muddy lamination is large, forming obvious lateral deformation and more secondary cracks. On this basis, the cuboid-shaped continental shale specimens were tested under true triaxial compression conditions to study the effect of laminations and interface cracks on crack propagation combining Acoustic Emission (AE) and CT techniques. It found that nascent cracks connected laminations and interface cracks to form fracture network under appropriate loading condition, tensile cracks developed in sandy lamination and shear cracks occurred in muddy lamination because of deformation dissonance and brittleness index differences, and more secondary cracks formed in muddy lamination with smaller fracture toughness. Moreover, the combination relationships between nascent and natural cracks mainly conclude direct penetration and deflection, which is affected by the filling degree and morphology of interface cracks and the relationship of lamination types. These conclusions show that laminar continental shale is conducive to forming complex fracture network, which can provide a theoretical basis for the proposal of indicators and methods for fracability evaluation.

KEYWORDS

Continental shale oil; mechanical properties of different lamination types; true triaxial compression test; structure control mechanism; fracability evaluation

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