Research on hydraulic fracture initiation and vertical propagation behavior in laminated tight formation

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Abstract: The extent of hydraulic fracture vertical propagation extent is important in evaluating simulated reservoir volume for laminated tight reservoirs. Given that it is affected by the discontinuities (beddings, natural fractures, and other factors), fracture geometry is complex in the vertical plane and is different from a simple fracture in a homogeneous formation. Because the tight formation bedding is very developed, hydraulic fracture is difficult to spread vertically. Now, the propagation mechanism of hydraulic fracture in the vertical plane has not been well understood. To clarify this mechanism, several groups of large-scale tri-axial tests were deployed in this study to investigate the fracture initiation and vertical propagation behavior in laminated tight formation. The influences of multiple factors on fracture vertical propagation were studied.

we carried out the indoor hydraulic fracturing physical simulation experiments of the bedding-developed rocks. Tight cores obtained from the core well were wrapped with cement into 30 cm cubes, and samples were drilled and cemented. Before the experiment, three-dimensional axial stress was applied to simulate the stratigraphic environment. When the stress was balanced, a certain flowing rate was set for hydraulic fracturing. After the fracturing work was completed, the cement block was opened to observe the hydraulic fracture propagation pattern.

The results showed that the ultimate fracture geometries could be classified into three categories: simple bedding fracture, slight turning fracture, stair-like fracture, and multilateral fishbone-like fracture network. Here comes some research knowledge: (1) When the difference between the
vertical stress and the minimum horizontal principal stress is less than 12Mpa, the hydraulic fracture will only expand along the rock bedding plane. Furthermore, (2) when the vertical stress difference is close to 14 MPa, hydraulic fractures will generate vertical fractures that will communicate multiple beddings of the rock. (3) Increasing flowing rate will cause a slight turning or jumping fractures and improve the complexity of fractures to a certain extent. (4) because of the influence of beddings and lithology, the fracture pressure is usually high.

**Key words:** Hydraulic fracturing, tight reservoir Bedding plane, fracture morphology.