

## 定向井井壁穩定壓力分析與裂縫再開裂壓力之研究

### An Analysis of the Borehole Stability and the Hydraulic Re-fracturing Pressure in Deviated Wells

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#### 摘 要

在鑽井工程開始前，為了避免井壁的坍塌，進行井壁穩定分析是必要的評估之一。包含大地主應力、定向井方位、地層材料性質、泥漿成分、井孔溫度等眾多因素皆會影響到井壁的穩定性。液裂法法則是廣泛運用在油氣的開採，之後更運用在大地應力的量測。本研究以考慮定向井方位、大地應力、孔隙壓力、岩石性質等因素，運用破壞力學方式討論井壁周圍應力狀況對於穩定壓力的影響。並依據 Rummel (1987) 的基本理論，考慮定向井狀態下，其定向井方位、大地應力、岩石斷裂韌度、裂縫長度、孔隙壓力等因素對於裂縫再開裂壓力的影響。

研究結果顯示：井壁穩定壓力的部分，其定向井方位對於井壁穩定壓力影響隨著應力狀態不同而不同；覆蓋應力增加時穩定範圍也會增加，當側向應力比增加穩定範圍則會減少；當井壁周圍的孔隙壓力上升時其穩定範圍會明顯變小；當岩石的凝聚力與內摩擦角越大時，其井壁穩定範圍也越大。裂縫再開裂壓力的部分，在不同應力狀態下的定向井方位對於再開裂壓力影響皆不同；當覆蓋應力增加時再開裂壓力也會增加，而當側向應力比增加時再開裂壓力則會些微減少；岩石斷裂韌度不影響再開裂壓力；大部分情形，裂縫長度較長時再開裂壓力也較大；井壁周圍孔隙壓力上升時會使再開裂壓力下降。

**關鍵詞：**井壁穩定性、破壞力學、Rummel。

#### Abstract

In order to avoid the collapse of borehole, the analysis of borehole stability is necessary before the start of the drilling project. There are many factors that affect the stability of the borehole wall, including earth stress, inclined orientation, formations physical properties, mud composition, and temperature of borehole. The hydraulic fracturing is widely used not only in the oil and gas exploration, but also in the earth stress measurements. In this study, we consider the factors including inclined orientation, earth stress, pore pressure, rock properties and discuss the range of the stable pressure by various stress conditions around the wellbore by stress analysis approach. In addition, Rummel's (1987) fracture mechanics approach was used in this study to evaluate the hydraulic re-fracturing pressure under different inclined positions, earth stresses, fracture toughness, crack lengths, pore pressures in inclined state.

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