# Stress Distribution and Fracture Characterization of Longmaxi Formation Shale in the Jiaoshiba Area, Southeastern Sichuan Basin, China

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## Abstract

Shale gas, which is an important type of unconventional gas resource, is widely distributed in the Paleozoic black marine shale in southern China and has broad prospects for exploration and development. Gas production from shale reservoirs heavily depends on successful hydraulic fracture stimulation. Present-day maximum horizontal stress controls the direction of hydraulic fracture propagation, and the geometry of the natural fracture system is important for effective hydraulic fracture treatment design. Our aim is to clear the stress distribution and fracture characterization of Longmaxi Formation shale in Jiaoshiba area. The results of borehole breakouts and drilling-induced fractures interpreted from nine borehole image data indicated that the maximum horizontal stress trends NEE-SWW. Fracture attributes, including orientation, size, and sealing properties, mechanical rock properties and subcritical crack index were collected from borehole image data, drilling cores and outcrops. We identify four types of natural fractures developed in the Wufeng-Longmaxi Formation shale. They include subvertical fractures, bed-parallel fractures, abnormal high-pressure-related fractures and fractures associated with concretions. Subvertical fractures and bed-parallel fractures are the most common types seen in study area. Bed-parallel fractures are nearly closed under lithostatic stress and would not provide storage and permeability, but they may act as planes of weakness during hydraulic-fracture treatment, resulting horizontal reactivation. Subvertical fractures that are partly or completely sealed

with cement are the most important for completions. We conclude that the development and distribution of subvertical fractures are controlled by geological structure, brittle mineral content and mechanical layer thickness. The geological structure is the principal factor that controls fracture development. The brittle mineral content shows positive correlation with the fractures quantity. The average fracture density decreases linearly with the increase of layer thickness. Three sets of subvertical fractures can be seen in Jiaoshiba area, namely NNE-SSW, NWW-SEE and NNW-SSE. Natural fractures trend dominantly NNW-SSE which is almost normal to the direction of SHmax. The results of this study can be used to optimize the drilling, completion, and stimulation of wells.