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Fracture Patterns in the Raton Basin of Colorado and New Mexico

The patterns and distributions of fractures within the Raton Basin are related to lithology, diagenesis, local structure, compaction, normal faulting, and thrusting. Many of the extension fractures and coal cleats strike nearly normal to the Laramide thrust front that bounds the western margin of the basin. Genetically related conjugate shear fractures with a bisector to the acute angle that is normal to the thrust front are also present in strata along the basin axis as well as at the eastern margin of the basin over 75 miles from the thrust front. Fracture orientations and surface features at some of the distal locations suggest horizontal shearing.

Fracture distributions in the basin are complicated by the presence of numerous igneous sills and dikes. Bedding-parallel igneous sills intruded the section at reconstructed depths locally in excess of 10,000 feet, suggesting an unconventional stress system where the overburden stress was not always the maximum stress at the time of intrusion despite relatively deep burial. Contraction of the dikes and sills during cooling caused intense fracturing of these units and potentially allowed significant volumes of coalbed-sourced natural gas to escape. This gas loss, together with pore dilation and pressure and temperature reduction associated with uplift and denudation, has resulted in the current underpressured basin-centered condition. The present-day in situ stress orientation in parts of the basin appears to be related to Rio Grande extension.