

Mechanical Properties of the Niobrara Formation, Rocky Mountain Region, USA

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Due to burial, subsidence, diagenesis and compaction, the Niobrara Formation requires horizontal drilling and multi-stage fracture stimulation. The unconventional characteristics of this major resource play in the Rocky Mountain Region is the reason why laboratory measurements of the mechanical and lithological properties of the Niobrara Formation will be presented in this work. This information is essential for designing hydraulic fractures in tight formations.

The samples used in this study were obtained from the CEMEX's Lyons Cement plant in Boulder County, Colorado, from where three lithofacies were sampled: the Fort Hays Member, the D chalk and the Lower Marl. For each of these facies, tensional and unconfined compressive strength were acquired in order to obtain a general failure criteria. Triaxial tests, using varying axial, confining and pore pressures, were conducted to obtain Young's modulus and Poisson's ratio values under different conditions, as well as changes in porosity and permeability. Also, ultrasonic velocity measurements will be done for establishing a correlation between static and dynamic properties, which can be used to extract mechanical properties from well logs.

These strength properties will be related to clay content, carbonate content, porosity and permeability, to determine which parameters have major or no influence in the fracture growth, length and extent. These properties will also serve to find numerical relationships that can be applied to other facies of the Niobrara Formation. It might be expected that the marl intervals in the Niobrara Formation contain the height of the simulated hydraulic fracture, due to their higher clay content in comparison to the chalk intervals, which would give them a plastic behavior.