

## **Factors Behind Variation in Geomechanical Properties of a Highly Lithified, Quartzose Sandstone**

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Gas is produced from fractured Jackfork Group sandstones in western Oklahoma. A Complex tectonic history has created multiple generations of fractures, leading to a major challenge in interpreting and predicting various factors which control the rock geomechanical properties, strength and fracturing potential. Quasi-static laboratory measurements of change in strain under increasing load were conducted on samples of highly lithified, tight, quartzose Jackfork along a well-exposed outcrop of an asymmetric anticline in south-central Arkansas, while ultra pulse velocity measurements were also conducted. Rock samples, as well as borehole image logs, were obtained from behind-outcrop cored wells and from both the steeply-dipping (average bedding dip 70 degree) and shallow-dipping (almost horizontal bedding) flanks of an asymmetric exposed anticline. Presence of numerous fractures primarily on the steeply dipping limb of the anticline allowed us to capture the variation in the geomechanical properties in both lateral and horizontal directions. Four sets of fractures trending north-south, east-west, northwest-southeast and northeast-southwest are present on the borehole image log at different depth intervals which cross cut each other at a few places. The mechanical parameters such as the stiffness or Young's modulus increase in magnitude towards the axis of the anticline. This observation and measurement is also correlated with the acoustic measurement, in terms of compressional and shear wave velocities. A newly designed rock testing device, the Inclined Direct Shear Testing Device (IDTSD) was used to measure strength- and stress- dependent acoustical properties on cylindrical Jackfork samples of 0.3" in thickness and 0.8" in diameter cut from shallow core. Presence of different grain sizes, microfractures and spatial location compared to the fold axis, and bedding dip are the key factors controlling mechanical properties of this tight quartzose sandstone.