

## **Source Potential and Geomechanical Characterization of the Barren Measure Formation Shale, Damodar Basin, East India**

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### **ABSTRACT**

The success of shale gas production in the United States has encouraged countries around the world to identify, evaluate and develop their shale horizons for tight gas/tight oil. There are several shale formations across the Indian sub-continent known for their potential source characteristics, however, there is little geomechanical data and insufficient knowledge about in-situ stress conditions, to develop these shale horizons as tight gas plays. This study evaluated source potential and included a laboratory study of the elastic and failure properties of the Permian Barren Measure Formation Shale. Rock-Eval pyrolysis measurements on 29 core samples from four boreholes yielded high TOC content (2.09 to 8.89 wt.%), with fair to excellent source quality from dominantly type III gas prone kerogen. The calculated reflectance ( $R_o$ ) ranges from 0.78 to 1.41%, suggesting wet gas generation stage. The XRD examination of these shales show abundance of clay minerals (avg. 57.2%) and silica (avg. 27.7%). This implies low mineralogical Brittleness Index with an average value of 0.28. The He-porosimetry indicated low porosity, ranging from 0.04% to 0.97%. Properly preserved core samples were subjected to standard laboratory triaxial testing for mechanical characterization in terms of strength, Young's Modulus, Poisson's Ratio, angle of internal friction, cohesion. The testing indicated values for the static Young's Modulus ( $E$ ) ranging from 8.96 to 23.44 GPa and static Poisson's Ratio ( $\nu$ ) ranging from 0.18 to 0.29. Using a Mohr - Coulomb strength envelope, the angle of internal friction ( $f$ ) was approximately  $37^\circ$  and the cohesive strength ( $C_o$ ) was inferred to be 24.13 MPa. The values obtained are analogous with the failure attributes reported in previous works on the tight gas/tight oil prospective Permian Roseneath Formation Shale in Cooper Basin, Australia. The Damodar Basin and the Cooper Basin were a part of eastern peri-Gondwana margin during Permian and share similar geological history and depositional trend hence qualify as suitable analogues. The Barren Measure Formation Shale showed brittle to semi-brittle deformation behavior during the triaxial testing with loading direction normal with respect to the bedding. In addition, the high Young's modulus and low Poisson's ratio values correspond high brittleness, so a good candidate for hydraulic fracturing operations.