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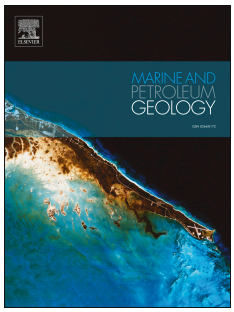

The effect of thermal maturity on geomechanical properties in shale reservoirs: An example from the Upper Devonian Duvernay Formation, Western Canada Sedimentary Basin

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The effect of thermal maturity on geomechanical properties in shale reservoirs: An example from the Upper Devonian Duvernay Formation, Western Canada Sedimentary Basin

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Abstract: Shale reservoirs are characterized by low matrix permeability and therefore require effective models of geomechanical properties to optimize drilling and hydraulic fracturing strategies. Both initial rock composition and thermal maturity are potentially critical controls on geomechanical properties. We investigate the Upper Devonian Duvernay Formation, Western Canada Sedimentary Basin, a major shale gas target that spans a wide range in rock compositions and thermal maturity to identify relationships between these parameters and geomechanical properties. Core hardness measurements and dipole sonic and density log data were used to characterize the geomechanical properties. Major element chemical analysis, X-ray diffraction analysis and LECO combustion were used to determine mineralogy, bulk rock chemistry and total organic carbon (TOC) content and to distinguish biogenic from detrital silica. Scanning electron microscopy (SEM) images with complementary energy-dispersive spectroscopy (EDS) maps were obtained for representative samples to document the rock fabric and distribution of organic matter and minerals.

Hardness and Al_2O_3 concentrations are strongly negatively correlated in all cores, regardless of thermal maturity, suggesting that clay minerals are the most significant factor controlling geomechanical properties. Biogenic silica is positively correlated to hardness. Detrital silica is negatively correlated to hardness, an artifact of the positive correlation between detrital clay minerals and detrital quartz. The positive correlations between CaO content and hardness in all