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Lower Triassic Montney Formation Petrophysics and Paragenesis

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Summary

The Lower Triassic Montney Formation of the West Canada Sedimentary Basin, with 450 BCF estimated reserves, is an example of a tight gas siltstone reservoir, with porosities typically between 0.56% and 4.9% and permeabilities between 0.001 and 5.4 md. This study explores the relationship between mineralogy, diagenesis and reservoir properties. Since, unlike sandstone and shale reservoirs, little is known about the diagenetic evolution of siltstones, a better understanding of diagenetic controls on reservoir quality in this type of reservoirs is essential.

Although it is commonly referred to as a gas shale, the Montney Formation actually contains very little true shale. The sediment comprising the reservoir is fine sand to silt in size, containing variably thick carbonate beds, mainly in the middle Montney section.

Diagenetic processes include formation of quartz, feldspar, plagioclase, carbonate, pyrite and marcasite cements, dissolution of quartz grains and authigenic illite crystal growth. Clay is abundant in some sections as inherited detrital grain coats, diagenetic pore filling and pore bridging illite and possibly as syndepositional infiltrated clay particles, creating meniscus bridging.

Quantitative mineralogical data from an upper and middle Montney core in northeastern BC, obtained by XRD analysis and supported by SEM imaging of core samples, provide evidence of rock composition and the origin of each phase (detrital or authigenic) and sheds light on the oxygen and pH levels in the sediment at the time of deposition. Statistical correlation analysis of the mineralogical data shows a distinct negative correlation between quartz and carbonates and a very strong negative correlation between both FeS_2 minerals and total clays to carbonates. Iron sulfides and total clays show a slightly weaker positive correlation to quartz to. Conventional plug analysis show great variability in porosity (0.5 - 5 %), which, in a smaller dataset, has a weak positive correlation to quartz and a negative correlation to carbonates. Permeability is not obviously related to mineralogy based on XRD data, and an understanding of permeability variation will require more detailed analysis.