THE IMPACT OF COMPOSITION ON PORE THROAT SIZE AND PERMEABILITY IN HIGH MATURITY SHALES: MIDDLE AND UPPER DEVONIAN HORN RIVER GROUP, NORTHEASTERN BRITISH COLUMBIA, CANADA

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ABSTRACT
Shale reservoirs of the Middle and Upper Devonian Horn River Group provide an opportunity to study the influence of rock composition on permeability and pore throat size distribution in high maturity formations. Sedimentological, geochemical and petrophysical analyses reveal relationships between rock composition, pore throat size and matrix permeability.

In our sample set, measured matrix permeability ranges between 1.69 and 42.81 nanodarcies and increases with increasing porosity. Total organic carbon (TOC) content positively correlates to permeability and exerts a stronger control on permeability than inorganic composition. A positive correlation between silica content and permeability, and abundant interparticle pores between quartz crystals, suggests that quartz may be another factor enhancing the permeability. Pore throat size distributions are strongly related to TOC content. In organic rich samples, the dominant pore throat size is less than 10 nm, whereas in organic lean samples, pore throat size distribution is dominantly greater than 20 nm. SEM images suggest that in organic rich samples, organic matter pores are the dominant pore type, whereas in quartz rich samples, the dominant type is interparticle pores between quartz grains. In clay rich and carbonate rich samples, the dominant pore type is intraparticle pores, which are fewer and smaller in size.

High permeability shales are associated with specific depositional facies. Massive and pyritic mudstones, rich in TOC and quartz, have comparatively high permeability. Laminated mudstone, bioturbated mudstone and carbonate facies, which are relatively enriched in clay or carbonate, have fairly low permeability.

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