Geochemical fractionation of organic matter as applied to unconventional petroleum reservoir quality

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This study presents a revised geochemical procedure using Rock-Eval analysis to quantify organic matter (OM) fractions in unconventional reservoirs. The results of a core sample from the Triassic Montney Formation tight gas reservoir from the Western Canadian Sedimentary Basin show that operationally-defined S1 and S2 hydrocarbon peaks from conventional Rock-Eval analysis may not adequately characterize the organic constituents of unconventional reservoir rocks. This method provided quantitative distinctions between major organic matter components of the rock, providing important information with significance for the evaluation of reservoir quality. Three major OM fractions, (i) volatile free light oil, (ii) medium to heavy range, fluid to semi fluid hydrocarbon residue, and (iii) solid bitumen (or pyrobitumen at higher thermal maturity) dominates the Montney tight gas reservoir. The majority of the total organic carbon (TOC) in the studied samples consists of solid bitumen that represents a former liquid oil phase which migrated into the larger paleo-intergranular pore spaces. Subsequent diagenetic alteration and thermal cracking of oil led to formation of consolidated aggregates of solid bitumen and pyrobitumen. Solid bitumen obstructs porosity and hinders fluid flow, and thus shows strong negative correlations with reservoir qualities such as porosity and pore throat size. We also find a strong positive correlation between the quantities of solid bitumen and pyrite, a relationship confirmed by petrographic evidence showing a close spatial association of bacterially-derived framboidal pyrite with solid bitumen accumulations in the intergranular paleo-pore spaces. These relationships suggest that solid bitumen and framboidal pyrite were both early products of bacterial sulphate reduction of liquid hydrocarbons following initial oil charging of the Montney Formation.