Combined Sequence Stratigraphy and Mudgas Geochemistry in the Western Canada Foreland Basin

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Sequence stratigraphic principles can give new insights into geochemical data from mudlogged wells of the west-central Western Canada Foreland Basin. Carbon isotope values and composition of hydrocarbon gases extracted from drilling muds while drilling do not vary monotonically as might be expected if the gases reflected increasing maturity with depth. The mudlogs show numerous inflections and variations in carbon isotope and gas composition that are correlatable over 150 km. Some of these inflections correspond with regional unconformities, indicating lateral but not cross-formational flow. Other inflections occur within formations suggesting intra formational compartmentalization of the gas. Boundaries to such compartments are often the sequence stratigraphic surfaces identified from geophysical logs. In our 6,500 sq km study area, subaerial unconformities mark on mudgas profiles a general downward transition from negative towards more positive isotope values. Maximum flooding surfaces mark a transition from overlying immature, towards more mature underlying gases. Ravinement surfaces have higher concentrations of heavier hydrocarbons, and mark inflections towards more negative carbon isotope values for ethane and propane. Every key bounding surfaces contrasts permeability and porosity between overlying and underlying rock units due to facies and grain size changes. From an exploration point of view, highly prospective trends may be at erosional subaerial unconformities, or other related bounding surfaces. Consequently, such surfaces will be the loci preferential fluid flow and will appear as anomalies in geochemical depth profiles. Linking sequence stratigraphy with mud gas geochemistry will constitute a more powerful toll in both academic and industrial fields.