

Characteristics of the Triassic Upper Montney Tight Gas Play, Groundbirch Area, Northeast B.C.

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Abstract

Lower to Middle Triassic strata in northeastern British Columbia constitute one of the most prolific petroleum systems in the Western Canada Basin, encompassing both oil and gas unconventional resources. A multi-disciplinary approach using a variety of data, including well logs, core, organic geochemistry and petrology, biostratigraphy, test data, as well as seismic and microseismic are integrated to characterize the resource and its depositional setting. As formation nomenclature varies across the provincial boundary; correlative reservoir stratigraphy immediately below the Doig Phosphate Zone is referred to as the Upper Montney (informal) in B.C. and thins into Alberta where it is termed Lower Doig (informal). The resource comprises a vast regionally continuous gas accumulation, spanning more than 100,000 km². Strata were deposited within a tapered west-facing marine ramp setting, in a semi-enclosed basin on the western margin of Pangea. Broad crustal flexure of the margin created significant accommodation space allowing for the thick accumulation of both source rock and reservoir.

Siltstone reservoirs of the Upper Montney/Lower Doig onlap a regional 2nd order sequence boundary, with distal offshore facies overlying proximal shelf facies in a back-stepping transgressive stacking order. The reservoir units feature a progressive deepening upwards trend characterized by distinct changes in organic petrology biofacies. The upper part of the reservoir succession contains deeper water indicators such as dinoflagellates, radiolarians, acritarchs, coccoliths, peloids and pellets; whereas the lower portion of the reservoir contains coccolithal alginites, land plant sporinites, as well as woody inertinite and vitrinite fragments. For the sequence, maximum flooding is imbedded within offshore source rocks of the Middle Triassic (Anisian) Doig Phosphate zone, comprising locally gas-mature (VRE=1.5 to 1.8%), organic-rich, phosphatic, shale and calcareous siltstone. Episodic upwelling and gravity flow deposition, resulted in a complex array of anoxic-dysoxic facies and organic enrichment (measured TOC from 3-7 wt% with TOC_{initial} up to 14 wt%). The Doig Phosphate Zone is a proven, prolific Type II kerogen source rock incorporating the maximum flooding surface separating the transgressive reservoir succession of the Upper Montney Formation below from coarsening upward regressive deposits of the Doig Formation above. Silt transport and deposition were affected by wave action, long-shore currents, storm events and gravity flow deposition. Oxygen-depleted conditions are indicated by sparse biota and stressed ichnofacies. Basin restriction is indicated by hypersaline formation water and by minor exotic clastic input derived from western source terrains. Reservoir attributes for the siltstones at Groundbirch include a 150-200 m thick interval with high net to gross ratio, 4-7 % average porosity, Sw of 20-40%, and overpressures approaching

the rock strength limit. Oil cracking and resultant bitumen plugging contributed to overpressures and pressure compartmentalization. Modeling indicates that overpressures intermittently exceeded the rock strength limit during regional uplift producing in-situ fracturing, preferentially creating high permeability domains in the shallow segment of the play. Development of the gas resource is taking place by pad drilling of long-reach horizontals stimulated with multi-stage fracturing. Micro-seismic imaging demonstrates tight linear fracture propagation at right angles to the Rocky Mountain front which imposes a pronounced stress anisotropy.

Groundbirch NE-SW Cross-Section (top Doig Phosphate datum)

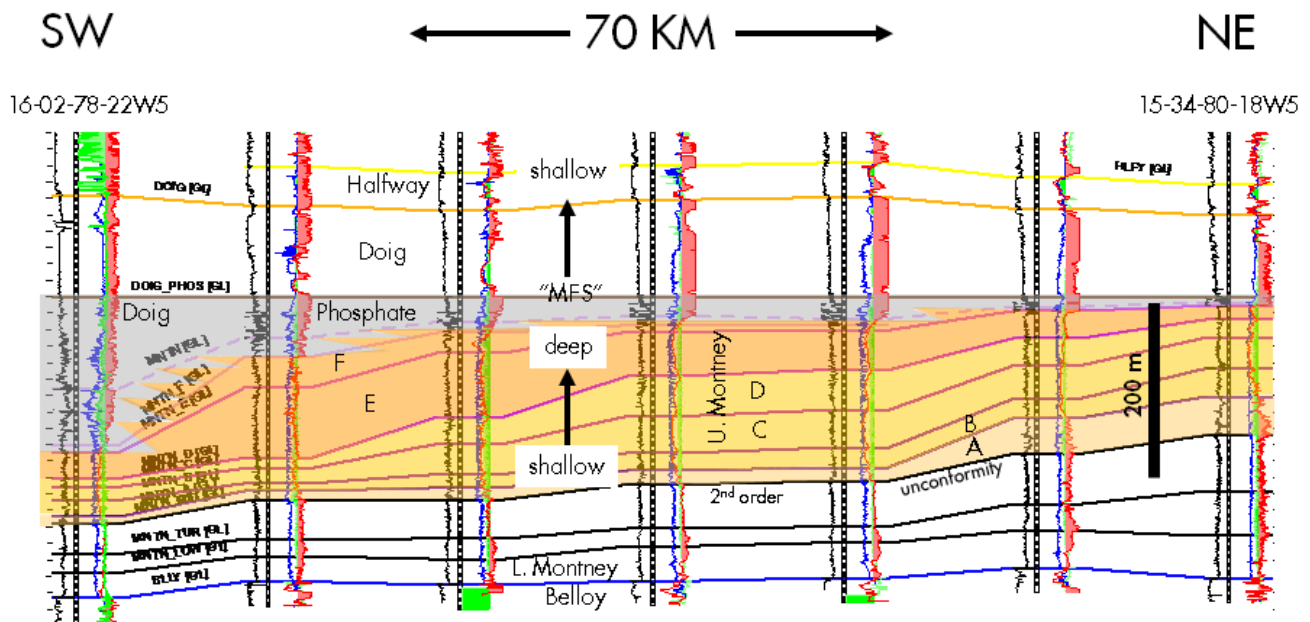


Figure 1. NE-SW cross section through Groundbirch area with datum set at top Doig Phosphate, with Upper Montney reservoir shaded in orange; logs are gamma (black), sonic (blue), density (green), resistivity (red)