

Fault-Controlled Hydrothermal Dolomitization of Middle to Late Devonian Carbonates of the Western Canada Sedimentary Basin

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ABSTRACT

Dolostones comprise some of the largest hydrocarbon reservoirs across the globe. However, significant uncertainty remains in terms of their formation, particularly reservoirs thought to have formed through fault-controlled hydrothermal dolomitisation. This study focusses on the variably dolomitised Devonian Swan Hills and Leduc Formations and Wabamun Group of the Western Canada Sedimentary Basin (WCSB), with core intervals selected based on their proximity to mapped platform-margin faults and/or regional Precambrian shear zones. Three contrasting types of dolomitisation were identified: 1. Fabric-retentive textures were found in partially dolomitised core from the Swan Hills Formation. Partial dissolution of stromatoporoids created mouldic porosity, with fractures and occasionally pores occluded by saddle dolomite cements. 2. Fabric-destructive textures were found in pervasively dolomitised cores from the Swan Hills and Leduc Formations, with a higher frequency of biomouldic pores, vuggy porosity and fractures (variably lined with coarsely crystalline dolomite cement) than in fabric-retentive dolostone. 3. Brecciated dolostone was observed in core from the Wabamun Group, with dolostone breccia fragments cemented by saddle dolomite and calcite. Observations indicate that fabric-destructive dolomite forms proximal to faults, with contrasting dolomitisation types within individual formations suggesting that fabric-retentive dolomite represents a more distal expression of fault-controlled dolomitisation. Porosity is primarily related to allochem dissolution, but cementation can significantly reduce this. As such, this study will provide insights into the formation and porosity distribution of fault-controlled dolostone hydrocarbon reservoirs within the WCSB and globally.