

The Slave Point Formation at Clarke Lake, British Columbia: An Example of Dolomitization and Hydrothermal Alteration by Long-Distance Brine Migration

Jeff Lonnee*

Shell International Exploration & Production, Inc., Houston, Texas
Jeff.Lonnee@shell.com

Hans G. Machel

Department of Earth & Atmospheric Sciences, University of Alberta,
Edmonton, Alberta

The Clarke Lake gas field in British Columbia, Canada, is hosted in Middle Devonian carbonates of the Slave Point Formation. The field consists predominantly of pervasive matrix dolomite with some saddle dolomite, the latter varying from zero vol-% in rare limestones to about 20-40 vol-% in dolostones, locally up to 80 vol-%. Saddle dolomite occurs as a replacement and as a cement. Both varieties are associated with dissolution porosity and recrystallized matrix dolomite.

Petrographic and geochemical data indicate that pervasive matrix dolomitization was accomplished by long-distance migration of halite-saturated brines at temperatures near 150°C. This differs markedly from most of the Devonian in the Alberta Basin south of the Peace River Arch, where pervasive matrix dolomitization was accomplished by advection of slightly modified seawater at temperatures of about 60–80°C. The saddle dolomites at Clarke Lake are not cogenetic with matrix dolomite and are not the product of hydrothermal dolomitization. Rather, they were formed by hydrothermal alteration of the matrix dolomite by a hybrid brine that originated from mixing of the halite-saturated brine with a gypsum-saturated brine. Fluid inclusion data suggest that hydrothermal alteration occurred around 230°C. A combination of burial curves, thermal modeling, and circumstantial evidence suggests that both pervasive matrix dolomitization and hydrothermal alteration took place during the Late Devonian through Mississippian. The sources of the halite- and gypsum-saturated brines are Middle Devonian evaporites situated roughly 200 km south and/or east of Clarke Lake, near the Peace River Arch.