Hydrothermal dolomitization and a fluid flow model: An example from the Middle Ordovician Trenton Group, southwestern Ontario, Canada

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Abstract

Middle Ordovician Trenton Group carbonates are fractured and extensively dolomitized along the axis of the Algonquin Arch in southwestern Ontario. Hydrocarbon reservoirs formed where these dolomitized fracture zones penetrate otherwise impermeable host limestones.

Three different types of dolomite (D1, D2 and D3) are distinguished. Petrographic characteristics and $\delta^{18}O$ values indicate that D1 formed during early diagenesis from Middle Ordovician seawater and recrystallized during progressive burial, whereas fracture-related, replacive matrix dolomite (D2) formed by hydrothermal fluids (68 to 99°C). Late-stage saddle dolomite (D3) and calcite (C3) cements occlude fractures. Based on petrographic, fluid inclusion, and stable isotope data, D3 dolomite and C3 calcite formed from warm (68 to 144°C), saline (22 to 24 wt. % NaCl+CaCl2) hydrothermal fluids.

Magnesium required for dolomite precipitation was supplied by Mg-rich seawater-derived (Silurian and/or Devonian) saline waters from the dissolution of Silurian evaporites which became heated during their descent along faults and fractures to reservoir depths at the center of the basin. Hot basinal brines migrated laterally through basal sandstones and ascended into the network of faults and fractures and precipitated fracture-related dolomite.