

Geopressured limestone Leduc reef reservoirs in the Wild River area, West-Central Alberta

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Most exploration in deeply buried Devonian carbonates is targeted for sour hydrocarbon accumulations in dolostones, because most limestones in these settings have very low porosities and are impermeable.

A major exception to this are overpressured, gas-bearing Leduc reefs in the Wild River area of West-Central Alberta. These reefs occur at present burial depths in excess of 4 km and attained estimated maximum burial depths of approximately 7 km in Eocene time. Gas accumulations in these reefs consist almost entirely of methane with original reservoir pressure gradients greater than 0.90 psi/ft. These gases also differ from the sour gas in nearby, normally pressured dolostone reservoirs in that H₂S concentrations are less than 10 parts per million. Furthermore, these limestone reservoirs have no producible water.

These reefs have recoverable gas reserves of approximately 10 BCF. Producing intervals have an average porosity of approximately 5% and an average core-measured permeability of about 1 md. Most voids are micron-scale intercrystalline pores in peloids and, to a lesser degree, in stromatoporoid fragments. Investigation reveals that larger primary pores were reduced or completely infilled by calcite and saddle dolomite cements in a hydrologically open-system during shallow to intermediate burial. Permeability is due to the presence of microfractures confined mainly to the more compact stromatoporoid particles. The overpressured limestone reef at well 15-19-56-23W5 initially produced at a rate of approximately 9 MMcf/d in 1992. Since then the production rate has steadily declined to the present rate of about 2 MMcf/d.

Microfractures in these reefs commonly have a subhorizontal to horizontal orientation and are lined by pyrobitumen with high birefractance values. This implies that the microfractures and other explosive deformation fabrics associated with open primary pores formed from excessively high geopressures created from the cracking of oil to gas in these reservoirs. These overpressured conditions reflect separation of the limestone reef reservoirs from the regional flow system. Hydrocarbon generation modelling by BasinMod 5.0® suggests peak gas generation in the reefs during Paleocene and Eocene times, corresponding to burial depths in excess of 5.5 km.

These geopressured limestone reefs offer an alternative to exploring for sour gas accumulations in dolostone reservoirs.