Fault-associated hydrothermally-dolomitized reservoirs (HTD) in Devonian strata of northeastern British Columbia: A large-scale geological exploration concept.

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INTRODUCTION

Deep Devonian reservoirs in northeastern British Columbia (Fig. 1), including the Chinchaga, Keg River, Sulphur Point and Slave Point formations, have been prolific gas producers since the 1950's. However, there is still abundant potential for high-impact gas discoveries along new and established exploration fairways.

Petrel Robertson Consulting Ltd. has undertaken an assessment of deep Devonian gas production and exploration potential in British Columbia for the British Columbia Ministry of Energy and Mines, Resource Development Division, New Ventures Branch. It highlights the importance of hydrothermal dolomite reservoirs as a key component of Devonian exploration potential.

Working from existing Petrel Robertson studies, new data from more than 500 wells and the published literature, this project addresses several key issues:

- Regional lithostratigraphic framework of Devonian units, and the distribution of economically important strata
- Paleoenvironments and paleogeographic setting of key units
- Present structural configuration, and the impact of the basement and structural lineaments on sedimentation and reservoir quality
- Dolomitization trends in the Slave Point, Sulphur Point, Upper and Lower Keg River, and Upper Chinchaga reservoirs
- Key stratigraphic and structural features, and how the integration of these elements can be used as an exploration tool.

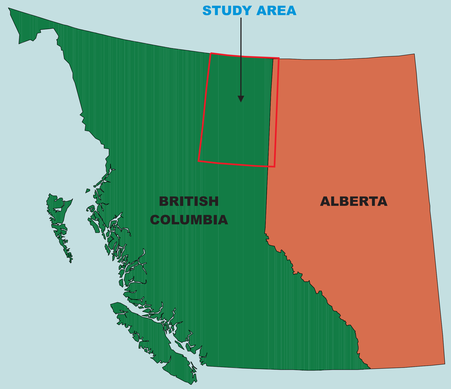
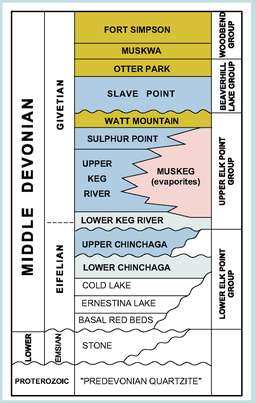


FIG. 1 - LOCATION OF STUDY AREA.



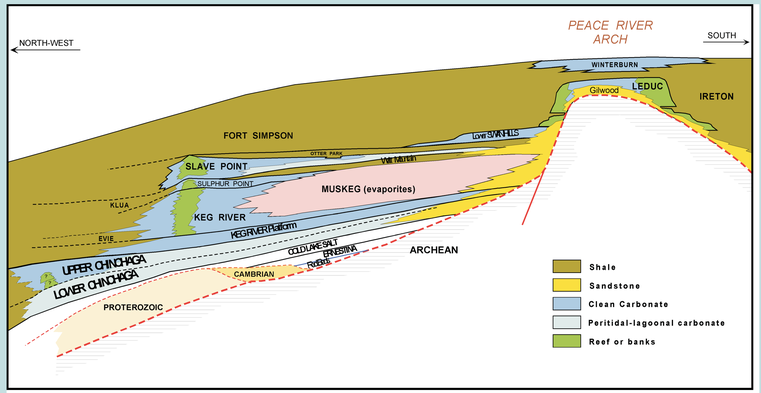


FIG. 2 - STRATIGRAPHIC ARCHITECTURE OF THE MIDDLE DEVONIAN IN N.E. BRITISH COLOUMBIA

THE LOWER ELK GROUP is comprised of four units: the “Basal Red Beds”, Ernestina Lake, Cold Lake and Chinchaga formations, formed by restricted and evaporitic lithofacies, and deposited within the topographic lows between the pre-Devonian Quartzite highs.

THE CHINCHAGA FORMATION is subdivided into two units by a regional unconformity, which follows a period of uplift and adjustment in the basin with a renewed influx of clastic deposition across the basin.

THE UPPER ELK GROUP comprises a number of lithostratigraphic units deposited in a rimmed carbonate platform setting. The bounding reef topography has traditionally been lumped as the Pine Point (Presqu'ile) Formation where dolomitized, and mapped as the “Presqu'ile Barrier”.

THE LOWER KEG RIVER (Keg River Platform) is relatively uniform across much of N.E. British Columbia, with thicknesses ranging from 20 to 50 metres (Fig. 4). The Lower Keg River marks the beginning of a widespread marine transgression with relatively deep-water deposits, represented by nodular and wavy-bedded mudstones-wackestones and are typically dolomitized.

THE UPPER KEG RIVER carbonate banks form the northern wall of the Elk Point restricted basin, reaching thicknesses of over 200 metres. Upper Keg River strata consist of stacked cycles, each with a shaly base, shoaling upward to a thick high-energy carbonate at top.

THE MUSKEG FORMATION ranges in excess of 200 metres in an area of maximum subsidence paralleling the Hay River Fault Zone and consists of interbedded anhydrite, dolostone and possibly halite, deposited within the restricted Elk Point basin. In the north, approaching the Keg River margin, dolomites thicken at the expense of evaporites, and small-scale cycles become more apparent.

THE SULPHUR POINT carbonates were deposited during a regional transgression over the Keg River and is mappable over much of the study area. In the south, the basal contact is sharp, as relatively high-energy peloidal grainstone-wackestones transgress the evaporitic Muskeg.

THE WATT MOUNTAIN FORMATION forms a distinct stratigraphic break between the Sulphur Point and Slave Point carbonates and is characterized by waxy green shales. The base of Watt Mountain marks a low-relief regional unconformity, resulting from a basin-wide tectonic adjustment and uplift on the Peace River Arch and other highs in the west.

THE SLAVE POINT FORMATION was deposited during a basinwide transgression, which ultimately drowned the Middle Devonian carbonate platforms of northeastern British Columbia and Alberta. It forms a thick and complex carbonate platform comprising several stacked shallowing-upward cycles. Reefal buildups and high-energy carbonate banks occur along the edges of the main platform (Fig. 4), and also along the margins of platform-interior embayments.

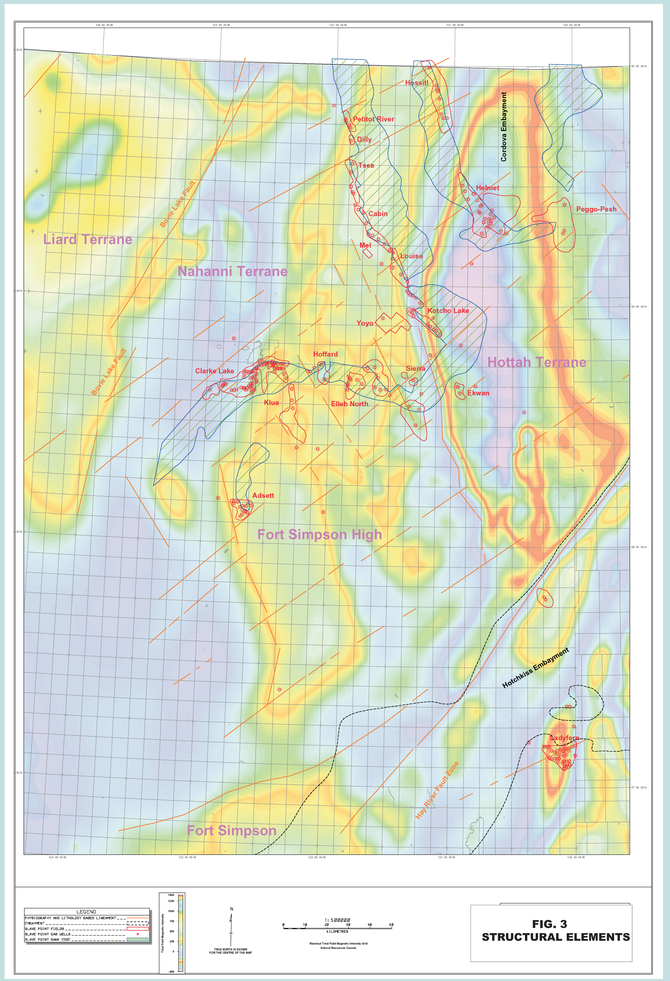


FIG. 3
STRUCTURAL ELEMENTS

Four main basement magnetic domains Liard Terrane, Nahanni Terrane, Fort Simpson High, and Hotah Terrane have been identified within the study area. Sharp magnetic gradients can be identified as domain boundaries and basement fault trends, such as the Hay River Fault Zone and Bovie Lake Fault Zone. In addition to these two zones, we have identified regional networks of SW-NE and NW-SE faults.

Structure played a major role in shaping the paleo-geography and reservoir development of northeastern British Columbia during Devonian time. Basin margins and bank edges were preferentially located along deep-seated faults that were active during deposition. Reactivation of deep-seated fault trends has exerted control over large-scale features such as platform margins and interior platform embayments, and over smaller features such as localization of isolated reefal buildups.

The Hay River Fault Zone has experienced numerous periods of reactivation and complex block faulting, from Proterozoic to Cretaceous times. During the Devonian, long-term subsidence along the Hay River Fault Zone recorded a regional thick in the Muskeg evaporates, argillaceous lower Slave Point time, and thick Otter Park-Muskwa shales.