Baffles and Barriers within a Braided Channel Complex - The Triassic Wolfville Formation, Nova Scotia

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Summary

This study investigates fluid migration within a braided channel reservoir and demonstrates how the study of outcrop analogs can identify the subtle changes in subsurface geology. Developing a geological model using outcrop data can lead to an understanding of how fluid migrates within these complex subsurface reservoirs. This study examines heterogeneity of a Triassic braided channel complex and identifies reservoir baffles and barriers, interconnectivity between channel bodies, and stratigraphic and structural compartmentalization.

Introduction

The Wolfville Formation outcrops along the shoreline of the Minas Basin in the Bay of Fundy of Nova Scotia (Figure 1a). Cambridge Cove contains an exceptionally well preserved outcrop section with 2D and 3D exposures of the braided channel deposits (Figure 1b). These outcrops demonstrate the stratigraphic complexities associated with this depositional environment.

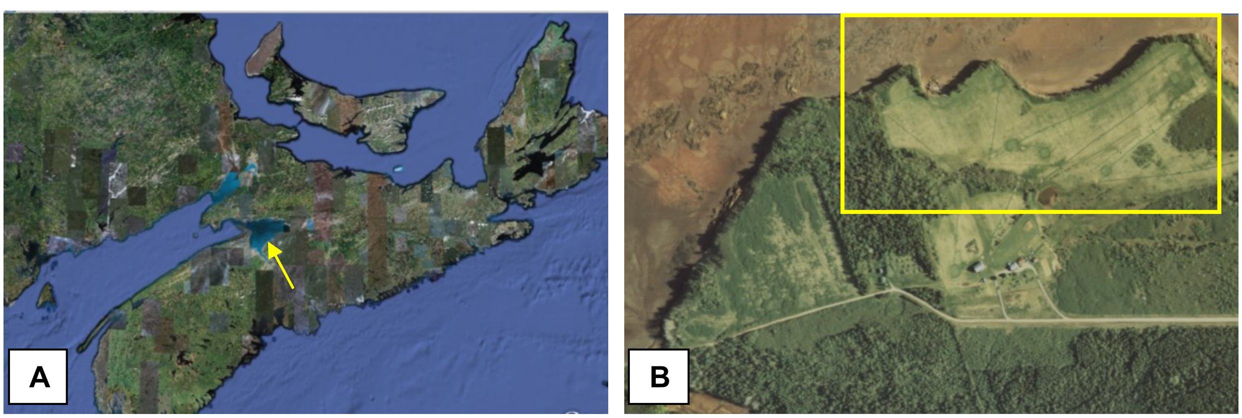

Figure 1a: Map of Nova Scotia with yellow arrow indicating aproximent location of the Cambridge Cove Study area (modified from Google 2009). **Figure 1b**: Areal view of the Cambridge Cove study area (NSDNR 1972).

The Wolfville Formation is the first formation that were lied down in the Fundy Basin during the Triassic. The sandstone and conglomerate beds of the Wolfville Formation lie nearly perpendicular overtop the steep trending shale and sandstone beds of the Lower Horton Group and define this as an angular unconformity. This unconformity between the two lithologies represents an approximant 40 million year hiatus of deposition and marks the point in time where uplift and erosion of the Carboniferous aged strata, gave way to subsidence and deposition of the Triassic aged sediments into the newly formed Fundy Rift Basin.

Methods

Data from measured sections of the outcrops, scintillometer gamma logs and permeameter measurements LiDAR, high resolution photogrammetry, ground penetrating radar(GPR) have been compiled and a geological model of the study area has been constructed in Petrel. The model demonstrates how the lateral continuity of the architectural elements control fluid flow through the higher permeable lithologies and impinges on the effective drainage of fluids in this simulated reservoir.

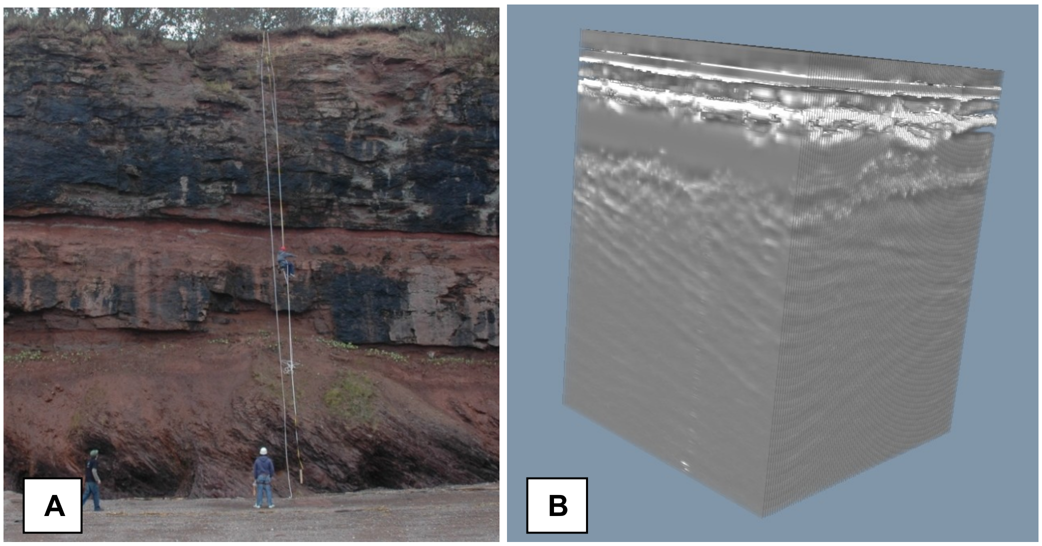

Figure 2a: Measuring sections, collecting scintillometer and permeameter measurements by repelling off the 20 meter cliff face. **Figure 2b:** 3D Shallow subsurface profile generated from collected GPR data.

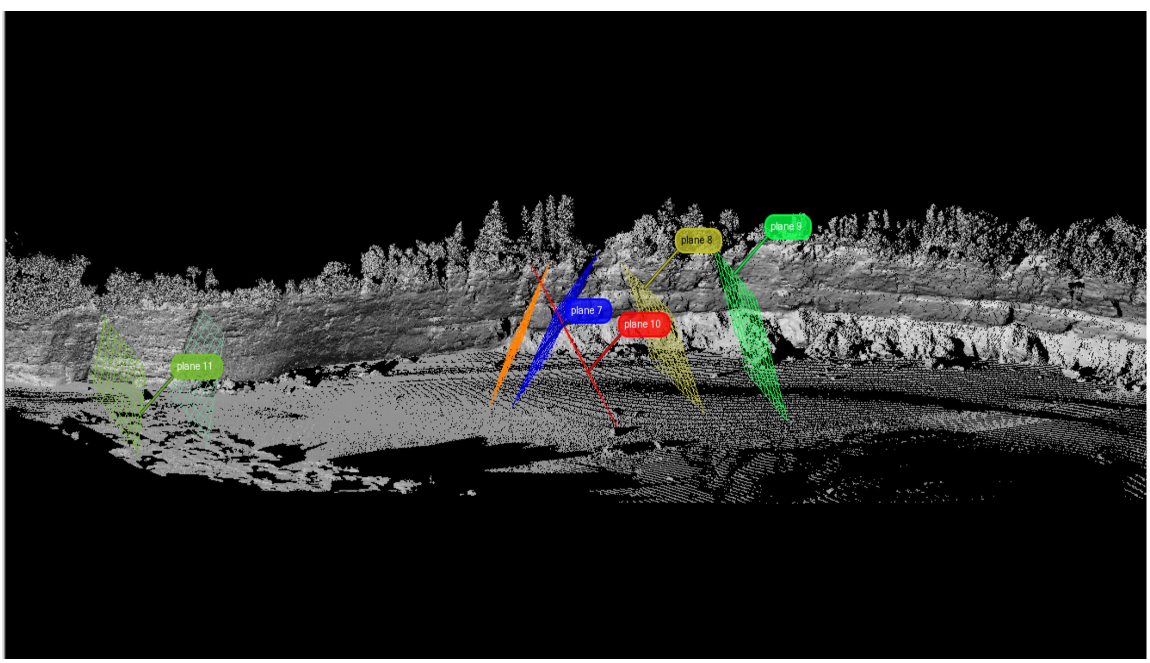

Figure3: LiDAR scan of Cambridge Cove outcrop. Fault planes demonstrate structural compartmentalization of the reservoir.

Results and Conclusions

Five measured sections collected at Cambridge Cove demonstrated the vertical and lateral heterogeneity of the braid channel complex. Three broad lithofacies were identified; clast-supported conglomerates, matrix-supported conglomerates and well-sorted sands. Two main sets of braid channels were identified and separated by interfluves deposits by apparent fine grained sands. The later extent of individual bar forms range from five to ten meters. These bars comprise pebble to cobble-sized conglomerate, to coarse grain sand. Fluid flow is expected to migrate along bed and bedset boundaries which form baffles to lateral vertical flow.

The interfluves deposits were expected to be impermeable baffles or barriers to fluid flow, but in fact acted as baffles and relatively permeable baffles, due to the fine and medium grained nature of the sediment. The underling unconformity with the Carboniferous strata is an effective barrier to flow marked by a line of seeps and springs at outcrop.

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