“Upper Grand Rapids Formation in the Cold Lake Field, Alberta”

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Abstract

The Cold Lake oil sands have been recognized for its huge reserves of heavy oil or bitumen under primary production. These deposits exist primarily in unconsolidated siliciclastic sediments within the Upper Cretaceous Mannville Group of Alberta[1]. In this paper, the interval of interest corresponds to a portion of the Late Albian – Lower Cretaceous strata, the Upper Grand Rapids Formation. These deposits occur approximately 300–400 meters below the surface. This study is focused on the integration of geological data in order to investigate the major controls on production performance.

The study area is located in the subsurface of East-Central Alberta, and represents a portion of the Cold Lake field. It encompasses 10 km^2 and is bound by the sections 13, 14, 23 and 24 in the township 62 range 5W4 (Figure 1).

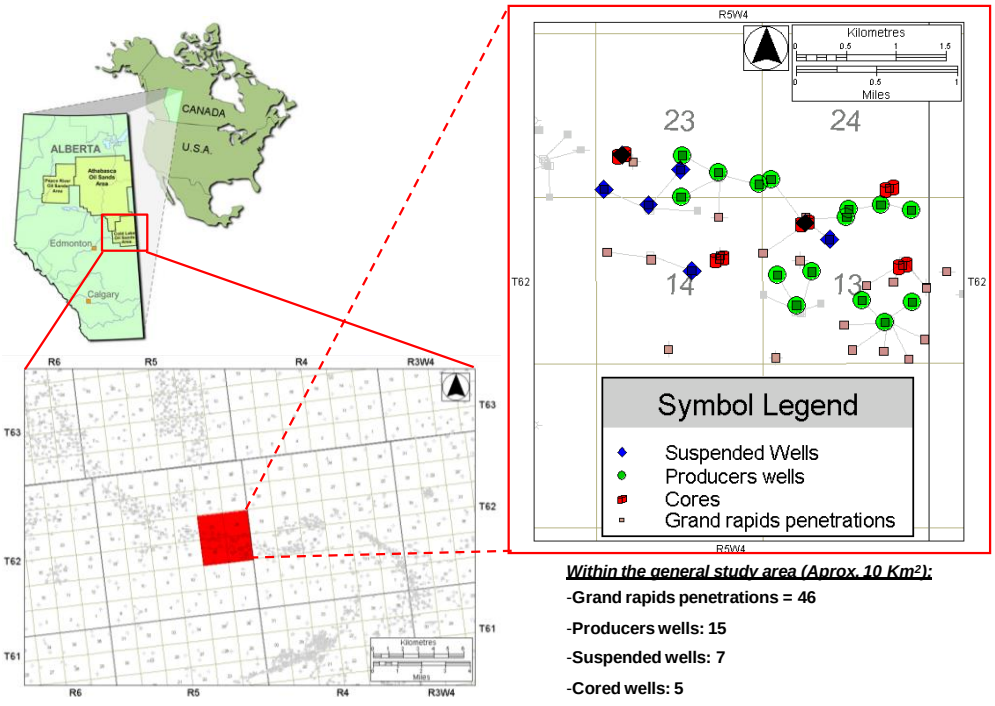

Figure 1: Location of the study area in the subsurface of East-central Alberta, Cold Lake Field. (Alberta Geological Survey, 2011).

Wireline well logs from 39 wells that penetrated the Grand Rapids Formation were selected to prepare stratigraphic correlations through the study area (Figure 2). These detailed stratigraphic sections led to define the stratigraphic architecture and geometry of the evaluated

interval in which the reservoir facies corresponds to a sinuous fluvial channel belt as described by Maynard et al., 2010[2].

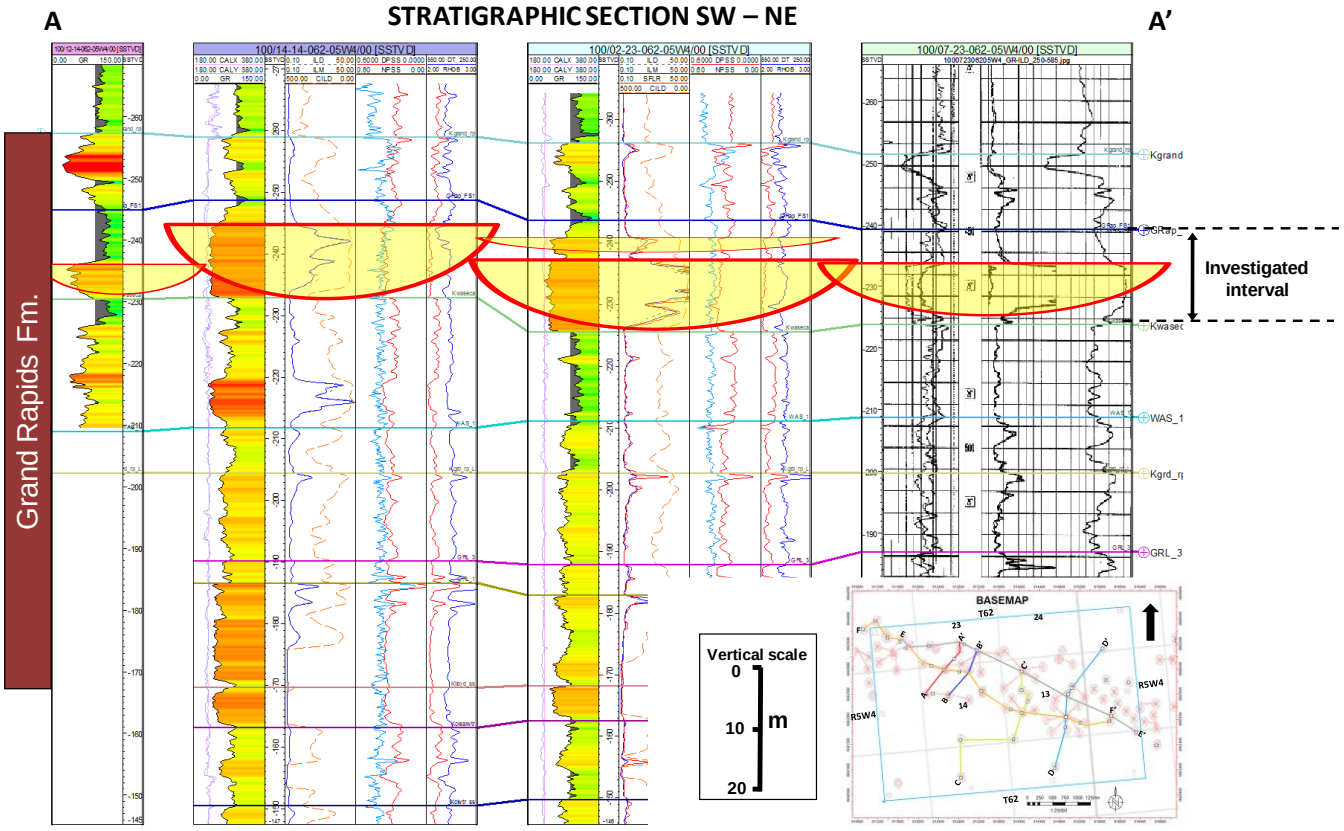

Figure 2:.Stratigraphic cross-section A-A' hung on the top of the Lower Grand Rapids Formation. This section is oriented southwest to northeast. The investigated interval consists of massive appearing sandstone beds. According to the Gamma ray log patterns and the literature this depositional setting is characterized by fluvial channels cutting across shoreface deposits. In this section the interval thickness is between 13 to 18 meters and it decreases along the axis of the basin. Net sand is shown in red and defined as 75 API units or less.

This deposit reaches up to 70 ft (21 m) in thickness, with bimodal porosity distribution between 31 to 35%, oil saturation ranges between 25% to 85% and, maximum horizontal permeability in the range of 176 milidarcy to 5 Darcys. The elevation of the reservoir is essentially flat with a low relive east (Figure 3). All wells are producing water independent of the structure of the reservoir. As a result, oil productivity has been significantly affected by water production, leading to early abandonment (1 to 3 years) before all recoverable oil has been extracted.

This geological examination reveals that the majority of the producers are located along the channel belt. Surprisingly, the best producers are not in the middle of the channel, but in areas with relatively low net to gross sand ratio (Figure 4). Further analysis of production data, allows the grouping of these wells in three different categories, according to their production performance (Figure 5).

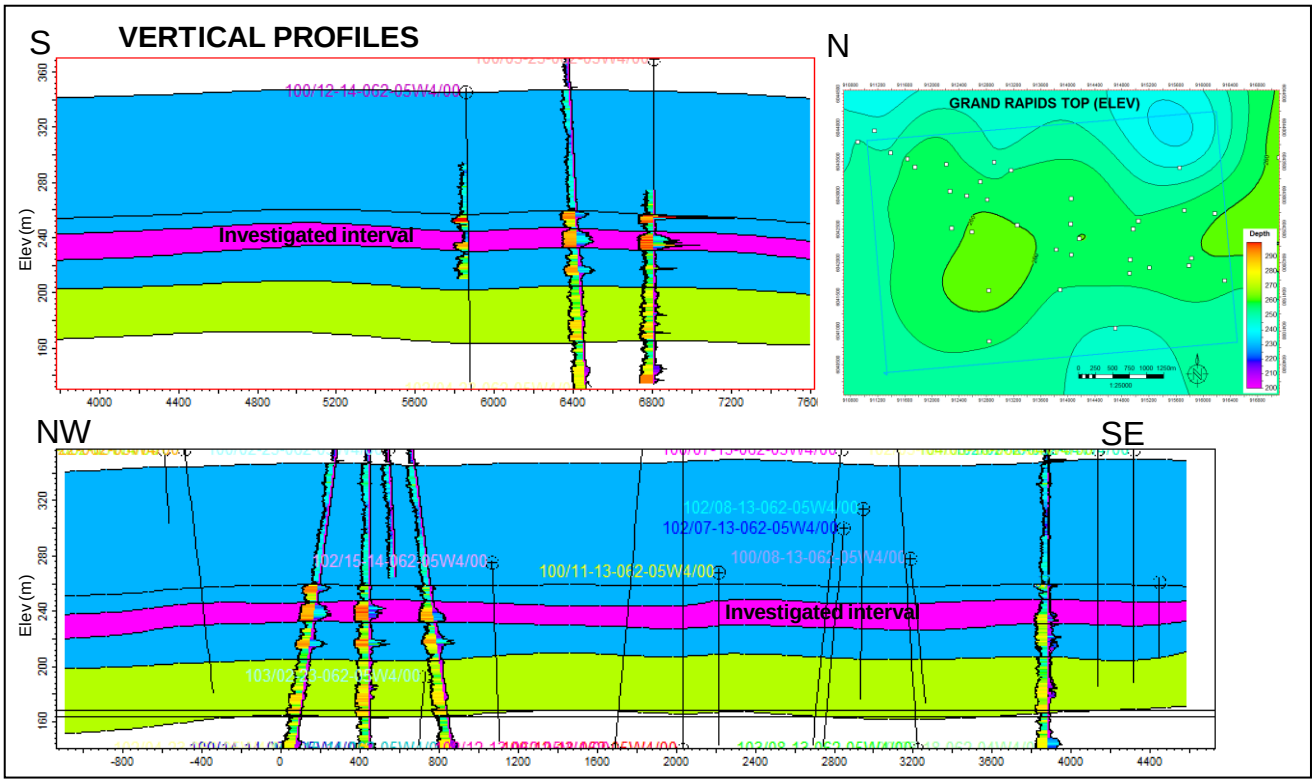

Figure 3: Vertical profiles showing the relative low relive across the study area. GR and ILD are shown for several wells.

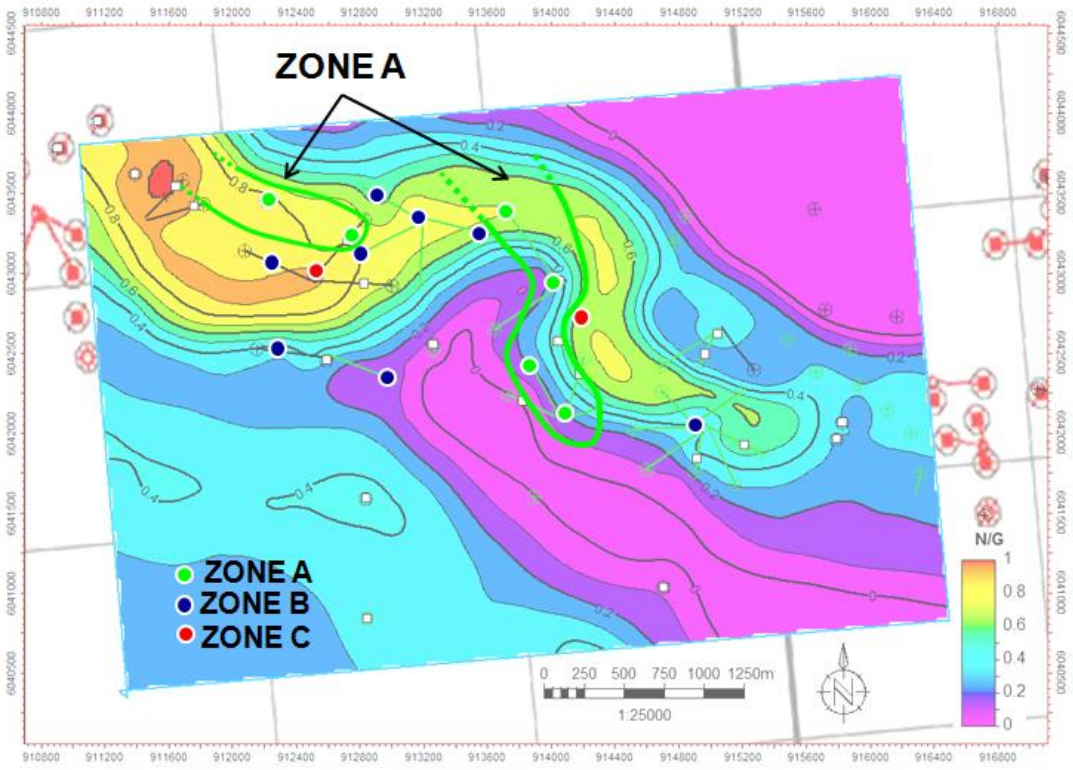

Figure 4: Net to gross map showing three different zones along the channel facies.

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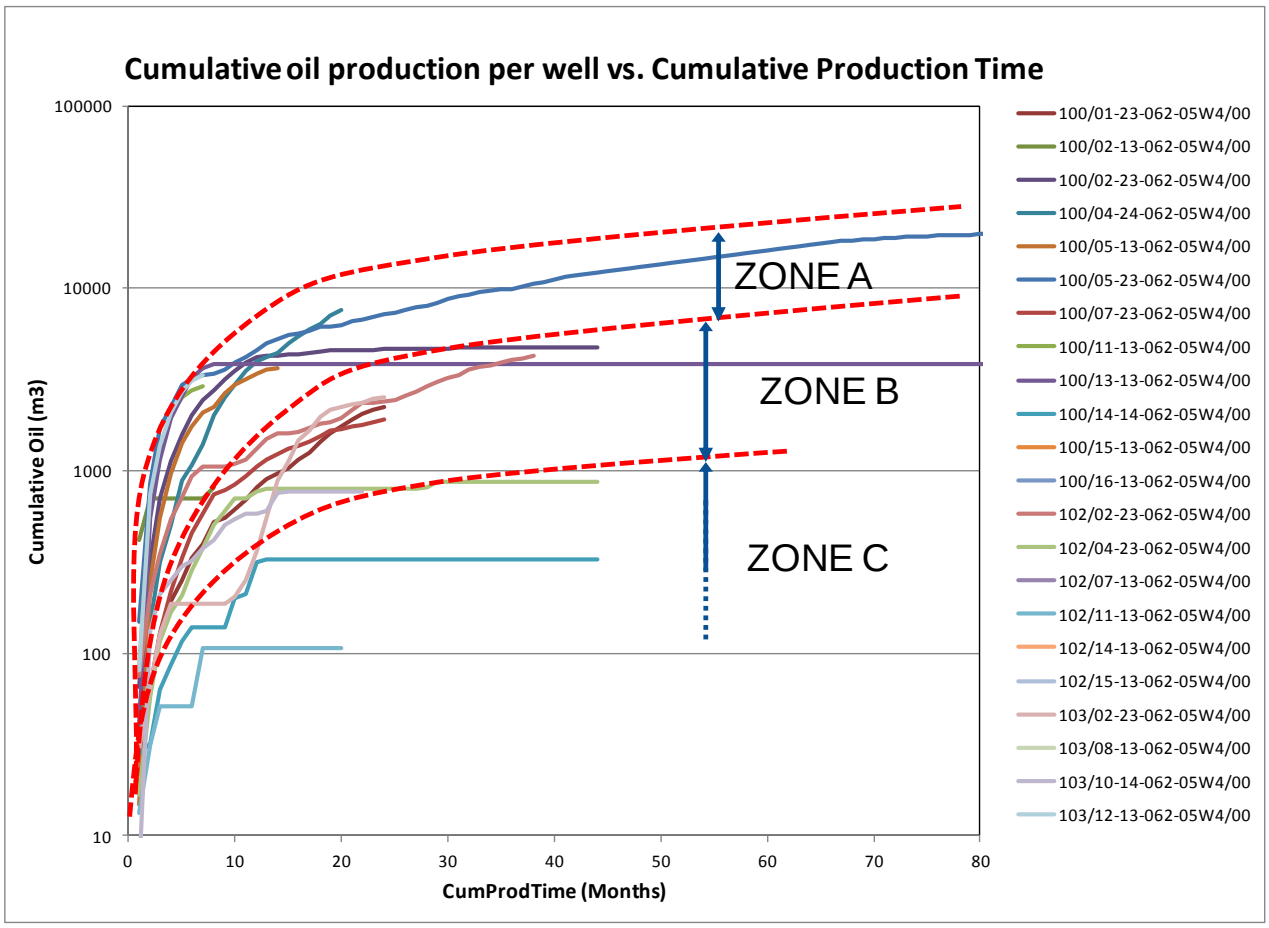

Figure 5. Cumulative oil production vs. cumulative production time for 22 wells, identifying 3 zones.

The observed behaviour might correspond to preferential water encroachment along the high net to gross areas in the channel belt. Thus, further development must consider appropriate location of the new wells to delay the water intrusion.

REFERENCES

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2. Maynard J., Feldman H.R., and Alway R. 2010. From bars to valleys: the sedimentology and seismic geomorphology of fluvial to estuarine incised-valley fills of the Grand Rapids Formation (Lower Cretaceous), Iron River Field, Alberta, Canada.