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Geologic influence on reservoir productivity in the Cardium Formation, Ferrier Oilfield, west-central Alberta, Canada

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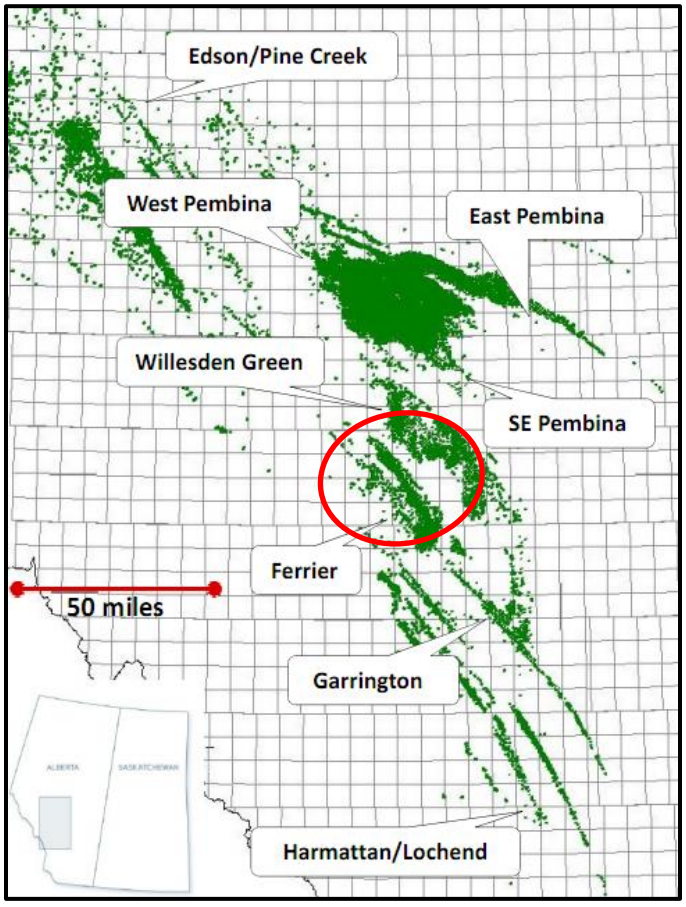
Summary

The Cardium Formation has been a prolific oil producer since the first oil discovery in the 1950s. Recently, the play has been revitalized due to the development of horizontal drilling and multi-stage fracturing technology targeting the lower reservoir quality "halo play" facies.

The main aim of this research is to understand the controls on abrupt lateral changes in oil and gas production in the Cardium Formation in the Ferrier Oilfield (base map in fig. 1).



In the Ferrier area, the Cardium Formation forms a NE prograding clastic sequence comprised of offshore to shoreface deposits sealed by marine shales. The main reservoir is comprised of sandstones and conglomerates interpreted to have deposited in a shoreface depositional environment. In the western portion of the oilfield the main reservoir body is composed by NW-SE oriented, discrete (2 to 3) clastic packages. An older, gas-charged sandy body is also present 30-40m deeper than the main reservoir in the western area. The older sand sequences shale out to the east, and only the youngest one comprises the eastern Ferrier Cardium reservoir.

Fig.1: base map of the main Cardium fields (mod. after www.canadian oilstocks.ca)

Two anomalous production areas in the Cardium were analyzed and interpreted (fig.2). The issue in case 1 is the presence of gas below oil. This is odd as the Cardium in the Ferrier is interpreted to be a laterally continuous clastic body with preserved fluid-dynamic connectivity. In case 1, gas is interpreted to have come from the gas-charged, oldest sand sequence and have reached the youngest sand body comprising the main reservoir migrating through a fault connecting the two. Once the gas reached the main reservoir, it migrated structurally up-dip towards the NE. The abrupt shift in GOR marks the boundary between the main oil reservoir in the east and the area in the west were gas is actively migrating structurally up-dip.
In case 2, a gas-producing area occurs in between two oil producing areas. This is odd as the three sub-compartments have similar depth and core oil saturation values. In case 2, clay cementation is interpreted to be one of the causes for the non-mobility of oil, with a potential role of strike-slip faults causing reservoir compartmentalization.
The Ferrier example offers a unique case of fluid discrimination in tight sandstone reservoirs due both to depositional and post-depositional factors, and could be used as analogue for similar situations in the WCSB and worldwide.

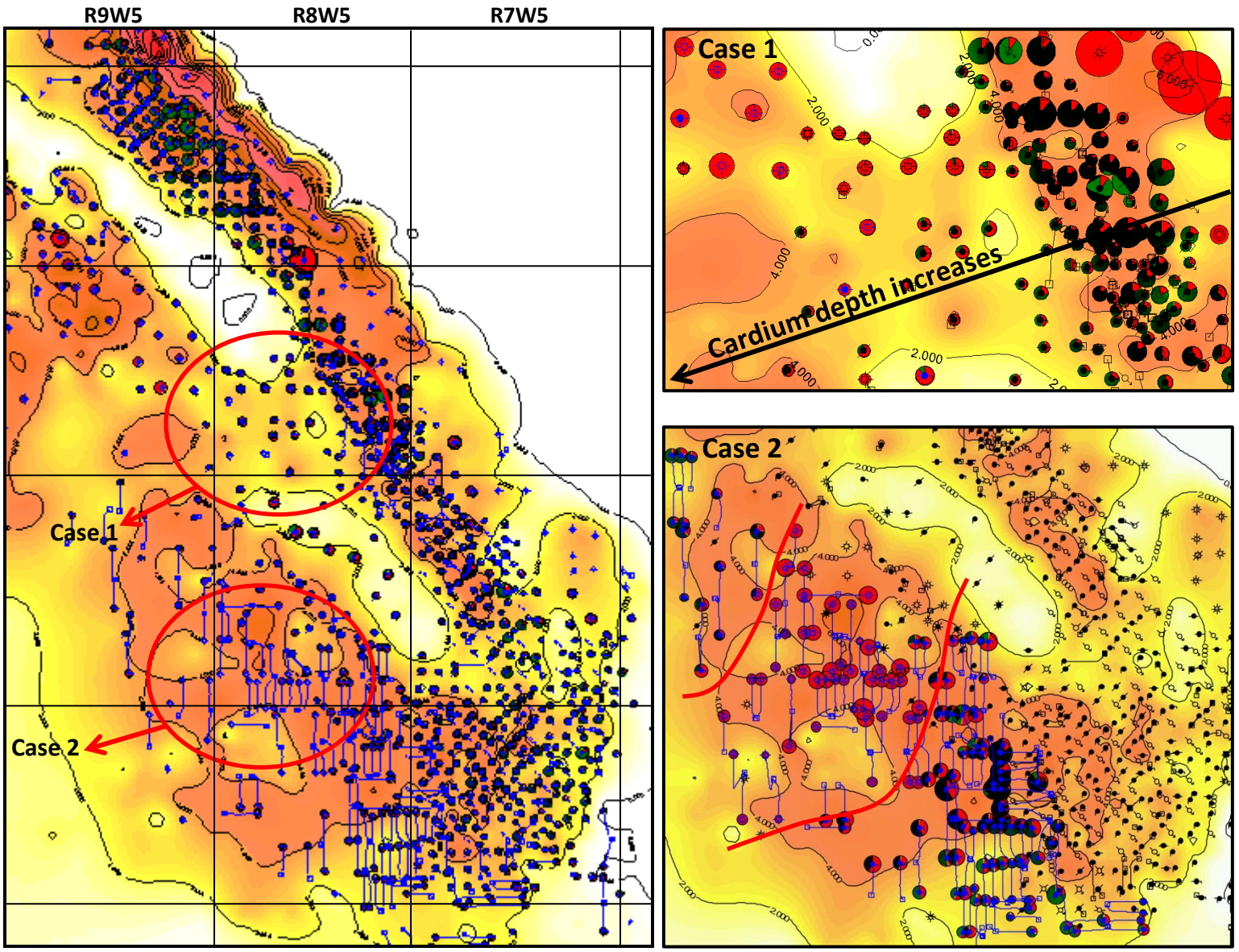


Fig.2: combined sandstone and conglomerate isopach map (m) with the location of the analyzed anomalous production issues.