

## **Examination of the Unconventional Resource Potential of the Mississippian Madison Group within the Williston Basin**

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### **Abstract**

The Mississippian Madison Group has historically produced more than 4.6 billion BOE (~90% oil) from over 32,000 vertical and horizontal wells spanning more than a dozen stratigraphic reservoir targets across both the US and Canadian portions of the Williston Basin. Initial geochemical fingerprinting studies during the 1970's proposed that Madison reservoirs were sourced by the underlying Bakken Formation. However, numerous ensuing geochemical investigations over the past few decades have concluded that Madison reservoir oils were instead primarily self-sourced by one or more sets of Madison petroleum source beds and not by the underlying Bakken Formation.

Recent work integrating core data with wireline logs has revealed the presence of petroleum source rock intervals within the upper Lodgepole/Tilston Interval and Bluell subinterval, which are both proximal to basin center and stratigraphically positioned near the base and middle of the stacked Madison reservoir subunits. Both the upper Lodgepole/Tilston and Bluell source rock intervals contain TOC values of 1-5% (by weight), plot along Type I/II kerogen signatures (hydrogen index versus oxygen index), reach gross thicknesses of 40 feet or more, extend at least for 10's of miles laterally in the subsurface, and appear to have reached the peak oil generation window (Tmax values of 436-456 °C).

Additionally, the overall permeabilities of the numerous Madison reservoirs collectively decrease moving from the basin margins (where most of the historical conventional Madison production has occurred) towards basin center, proximal to the Madison source rock intervals. Furthermore, Madison exploration and development in the late 1970's to early 1980's within the Mondak field area (west central North Dakota) included vertical wells with perforations that spanned upward of several hundred feet (gross), targeted multiple stacked Madison reservoirs with sub-millidarcy permeability and utilized hydraulic fracture stimulation for well completions.

Considering the conventional production volumes along the basin margins, the presence of at least two thermally mature source rock intervals, and the presence of low-permeable reservoirs proximal to basin center and the previously noted source rock intervals, the Mississippian Madison Group may contain substantial unconventional resource potential.

Petroleum Systems in the Rocky Mountain Region    Monday, July 25    2:00 PM