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Identification and Evaluation of New Resource Oil Plays in Northeastern British Columbia

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Horizontal drilling and multiple-stage hydraulic fracturing (multi-frac) stimulation technologies have greatly augmented gas and liquids resources and reserves in the unconventional reservoirs of British Columbia over the past several years. However, little new unconventional oil potential has been identified, even though substantial conventional oil pools have been produced for decades. To address this issue, Geoscience BC commissioned a study to determine the potential for new tight oil exploration and exploitation fairways, accessible through modern drilling and completions technologies.

Clarkson and Pedersen (2011) analyzed the spectrum of known unconventional oil plays, and assigned them to three categories:

- Tight oil plays—clastic or carbonate rock reservoirs with low permeability, requiring horizontal drilling and multi-frac stimulation to produce oil at economic rates. The middle Bakken Formation sandstone of the Williston Basin and portions of the Montney Formation in Alberta and BC are good examples.

- Halo oil plays—lower permeability fringes flanking conventional clastic and carbonate rock reservoirs, which can be developed with horizontal, multi-frac wellbores to enlarge the original play area. Halo oil plays may extend vertically from a conventional pool, as well as laterally. The Cardium Formation in west-central Alberta is the best Canadian example.

- Shale oil plays—oil accumulations hosted by true shales and/or mudrocks. These are relatively rare, and there is a body of work suggesting that pore networks in true shales can produce liquids-rich gas, but not actual oil (Dembicki, 2014). The Second White Specks Formation of west-central and southern Alberta has been suggested as an example of a shale oil play, but detailed work suggests that associated tight sandstone beds with extensive natural fracturing are responsible for much of the production. Appraisal of other potential shale oil reservoirs, such as the Duvernay Formation and Gordondale Member has failed to produce oil at economic rates to date.

We identified twenty-one potential resource oil plays in northeastern BC, and classified them according to their overall productive potential, based upon our extensive knowledge of BC conventional and unconventional petroleum geology. We compiled existing analytical data to support play analysis from the technical literature, government survey reports and analytical files submitted to the BC Oil and Gas Commission (BCOGC) by operators. We grouped the information into several categories, including: source rock analysis, adsorption/desorption tests, x-ray diffraction and x-ray fluorescence (XRD and XRF), scanning electron microscopy (SEM), standard petrographic (thin section) analysis, and geomechanical testing.

Comparing existing analytical data against the spectrum of resource oil plays, we identified and completed new laboratory sampling of cores and analytical testing to fill gaps in existing datasets. We also completed reservoir engineering analysis of potential resource oil plays with two primary goals: characterizing the fracability of potential reservoirs, and identifying fairways where existing oil production data suggest the presence of substantial oil resources occurring in low-permeability halo accumulations.

Project outputs include:

- reservoir mapping and facies characterization, related to existing conventional pools;
- reservoir quality assessment, incorporating mineralogical data and porosity/permeability characteristics;
- assessment of geochemistry (source rock analysis), hydrogeology and fluid distributions;
- identification of abnormally pressured fairways, where present; and
- assessment of geomechanical properties and resulting productive potential.

Our assessment suggests that targeted exploration and appraisal may establish substantial new resource oil potential in northeastern B.C.

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References

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