Exploiting the Grosmont Formation from Underground: Reducing the Footprint of Thermal Heavy Oil Production

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The Upper Devonian Grosmont Formation in the greater Saleski area of northern Alberta is a bitumen-bearing carbonate unit with an estimated 50.5 billion cubic meters (318 B bbls) of bitumen in place (ERCB, 2008). Osum has interests in 137 gross sections (97 net sections) in the greater Saleski area where the bitumen column is thick, porous, highly permeable, and richly saturated. The Grosmont Formation is informally subdivided into four units. These are, from oldest to youngest; the Grosmont A, B, C, and D. In this paper we propose thermal and/or solvent techniques for exploitation that access the reservoir in the Grosmont C and D from wells that initiate from a tunnel located in older strata below the reservoir, within the Grosmont B.

In the Saleski area, the Grosmont B has an average stratigraphic thickness of 16 meters and dips gently at 0.2 degrees to the SW. The Grosmont B comprises three limestone facies identified in core, recognizable in log response, and easily correlated between wells. At the base is a fissile calcareous shale that grades up into the middle facies, a one-meter thick oil-stained amphipora and stromatoporoid floatstone. The top facies is a nodular lime mudstone with light oil-staining and vertical fractures that are both open and calcite-filled. This succession of facies is interpreted to have been deposited on a carbonate platform in progressively shallowing water depths. The Grosmont B was not dolomitized during early diagenesis and as a result was predominately impermeable to meteoric waters during the Late Jurrasic to Early Cretaceous exposure event (Machel and Huebscher, 2000). Meteoric diagenesis resulted in extensive alteration in the Grosmont C and D; including, solution enhanced fractures in the Grosmont C (Russel-Houston *et al.,* 2009), and stratiform brecciation in the Grosmont D (Hopkins and Barrett, 2009). The conformable contact between the Grosmont B the Grosmont C is sharp and represents a flooding event. Overlying the Grosmont B is a 15 meter thick non-reservoir unit within the Grosmont C that is assigned to two facies; a basal massive argillaceous dolomudstone and an upper nodular dolomudstone with rare vertical fractures. This non-reservoir unit within the lower Grosmont C will act as the barrier between the tunnel within the Grosmont B and the thermal or solvent development within the upper Grosmont C and Grosmont D.

The proposed underground well recovery system utilizes concepts which were developed at the Underground Test Facility (UTF) near Ft. McMurray. The expansion of the proven recovery method at the UTF into a commercial sized production facility offers a viable, efficient alternative to conventional surface thermal operations with the added benefit of a reduced surface footprint area. Initial construction of the underground well system would consist of constructing shafts and/or decline tunnels to the depth of the Grosmont B. After access is established, a series of tunnels and chambers would be constructed to provide the infrastructure development for the underground well system including a centralized pumping chamber complex, maintenance facilities, and interconnecting access tunnels. The underground well system would be developed in a sequential series of tunnel panels constructed from the access tunnels, with each panel consisting of three parallel tunnels. One outer tunnel would provide access for construction, materials, and fresh air ventilation. The other outer tunnel would house the steam injection and bitumen product pipelines as well as the exhaust portion of the ventilation. The center tunnel would be designated the drilling tunnel and would house drill chambers on predetermined centers from which well pairs are drilled up into the bitumen-bearing formations above in opposite directions. Tunnels within each tunnel panel are constructed successively to accommodate a systematic well pair drilling sequence for both safety and resource recovery purposes. Due to the difference in elevation between the collector hole of the well pair and the product pipeline, gravity is utilized in lieu of down hole pumps to move the bitumen product from the wellhead back to the centralized pumping chamber. From here the bitumen product is pumped to the surface where it is processed in the same manner as a conventional surface thermal project.

The underground well recovery system offers several benefits. As a result of placing the network of roads, pipelines, and well pads below ground in the tunnel complex, the surface footprint is reduced by an estimated 86 percent as compared to conventional *in situ* development. The ability to operate at minimal formation pressures as demonstrated at the UTF project, combined with a centralized pumping system versus hundreds of in-line, down hole pumps, provides for potential lower fuel usage and corresponding greenhouse gas emissions as well as decreased operating costs. Additionally, the ability to operate year round in an ambient climate eliminates many cold weather related issues and offers the possibility of increased worker productivity. Finally, the the well pairs do not penetrate the overlying cap rock or near surface aquifers. In light of today's challenges to develop oil sands resources in a greener and more efficient manner, the environmental and operational advantages offered by the underground well recovery system create the potential to change the way we look at bitumen extraction.

References

ERCB (Energy Resources Conservation Board), 2008. Alberta's Energy Reserves 2007 and Supply Demand Outlook 2008-2017. Statistical Series, ST98-2008, pp. 226.

Machel, H.G. & Huebscher, H., 2000. The Devonain Grosmont heavy oil reservoir in Alberta, Canada. Zentralblatt fur Geologie und Palaontologie, Teil 1, vol. **1/2**, p. 55-84.

Hopkins, J, and Barrett, K. 2009. Stratiform Carbonate Breccias of the Grosmont Formation, Alberta. Extended Abstract, 2009 CSPG CSEG CWLS Convention, Calgary, p. 18-21

Russel-Houston, J., Rott, C., Putnam, P., McGrory, R., 2009. The Grosmont C at Saleski, Northern Alberta: a Solution Enhanced, Highly Fractured Dolomite Reservoir. Extended Abstract, 2009 CSPG CSEG CWLS Convention, Calgary, p. 40 to 44.