Reservoir Characterization of the Grosmont Formation at Saleski, NE AB: A Multi-Disciplinary Data Integration Exercise in Progress

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Summary

The Upper Devonian Grosmont Formation of northeastern Alberta is a giant bitumen reservoir that holds an estimated 318 billion barrels in place (AEUB, 2005) and consists of pervasively dolomitized and heavily karsted carbonates. The bulk of the bitumen accumulation lies in the two uppermost stratigraphic units informally called UG2 and UG3. Over Husky's acreage, which almost entirely lies along the Grosmont subcrop edge and where the cumulated gross thickness of the two units ranges between 40 and 70 meters, the Grosmont reservoir architecture is characterized by both a significant depositional control and an intense karst overprint. Consequently, the flow units tend to show good lateral continuity as well as a high level of small to medium scale internal heterogeneities.

The best reservoir rocks occur in two very distinct types of reservoir units:

1- Multilayer units are found in the peritidal assemblages of UG3 and Upper UG2. Those units consist of finely layered associations of the following four main lithofacies groups:
   - An enigmatic unconsolidated facies made of very finely crystalline dolomite rhombs held together by bitumen. This facies can either be homogeneous or brecciated, and is generally highly porous (average 32%).
   - A group of competent, fine to medium crystalline dolomitic facies that include peloidal, fenestral and vuggy fabrics, and displays moderate porosity (average 20.5%).
   - A group of laminated facies that include tidal flat and algal mat laminites, with an average porosity of 27%.
   - Argillaceous interbeds.

Horizontal permeability varies significantly from one rock type to another. Core measurements show values ranging from 5 to 500 mD in the competent rocks, and up 1 to 5 D in the unconsolidated and laminated facies. True vertical matrix permeability at the scale of a reservoir unit is unknown but likely to be significantly lower than horizontal permeability due to the presence of argillaceous interbeds.

2- More massive reservoir units consisting of a vuggy fine to medium crystalline dolomite are present in the basal and middle part of UG2, in association with subtidal deposits. They commonly display a crackled texture conferred by small-scale randomly oriented fractures. These units and facies are laterally extensive and correlatable over long distances. The small scale heterogeneities present in these units are the result of an ever-changing mix of

intercrystalline, vuggy and fracture porosity. The average porosity is 19%, and the vertical and horizontal permeability values are in the 100-500 mD range.

Naturally occurring fractures are visible on cores and resistivity imaging logs. A semi-quantitative analysis of available FMI data indicates a density of fractures close to one per meter, with highly variable orientations. The scatter in fracture orientation suggests karst-related fracturing due to the collapse of caverns and cave passages. The fracture density strongly supports a dual porosity system for this reservoir.

Sinkholes and collapse features, ranging between 15 and 55 m in thickness, were also encountered during recent drilling operations. They were all filled with non reservoir chaotic breccias composed of Devonian blocks of variable size in a matrix consisting of Cretaceous silt, clay (kaolinite) and occasional coal debris. The largest collapse features are recognizable on seismic data.

A 3D geostatistical modeling process is anticipated for the Grosmont reservoir at Saleski. The modeling process will have to account for all scales and types of reservoir heterogeneities that are relevant to fluid flow in a thermal recovery context. Detailed petrophysical studies, core-flood experiments and history matching of the existing historical pilot data are currently underway and will be integrated with the geological interpretation during the modeling process. Multi-disciplinary integration and innovative research and development work on recovery technologies will be critical to successfully produce the bitumen from the extensive Grosmont play.