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Multicomponent Time-Lapse Monitoring of bitumen Recovery and Geomechanical Implications

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Abstract

In-situ recovery of bitumen resources in Northwestern Canada occurs in the near surface (deeper than 75m and typically less than 600m). The recovery method patented and used by Petrobank is known as Toe-to-Heel-Air-Injection (THAI®), which is an in-situ combustion process that is used for the recovery of bitumen and heavy oil. It combines a horizontal production well with a vertical air injection well placed at the toe. This is an in-situ combustion process which burns the heavy end asphaltenes of the bitumen to mobilize and upgrade oil in-situ, while recovering up to 65% of the bitumen. Because of the shallow depth of operation in combination with the properties of bitumen, where the oil is part of the formations matrix, this process produces large changes in the reservoir and also in how the formation carries and distributes a load (Wikel, 2012). Therefore, this affects how the reservoir and overburden distribute regional and local stresses. This requires monitoring of the reservoir during combustion and for stress changes in the formation of interest. In addition to this, the overburden must be monitored and studied to ensure cap rock integrity through time. This will help us avoid well damage or surface venting of pressure. Time lapse multi-component studies are well suited for this purpose.

Data from the Conklin THAI pilot show that the combustion front is moving toward the heels of the wells in a non-uniform pattern (Kendall and Wikel, 2011) and that PS1/PS2 anomalies in the overburden are caused by changes in the stress state through time (Wikel et al., 2012). In addition to this, new data has shown that front movement has changed with time and operational improvements. Also, stress directions and magnitudes in the reservoir and overburden have changed as the front has progressed from 2008-2011. Well deformation in the area can be directly attributed to stress changes in the overburden. These changes have implications for how the pilot is managed in the future. Examples from past and new data sets will be shown along with drilling and operational data from the pilot facility.