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Large Scale Compensational Stacking: Clearwater – Lloydminster and Lower Grand Rapids formations, Southern Alberta

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Devon Canada completed a regional stratigraphic study that includes its key assets in the oil sands and heavy oil areas of central and southern Alberta in order to develop a sequence stratigraphic framework for the Aptian-Albian Mannville Group. This paper focusses on key findings within the Clearwater – Lloydminster and Lower Grand Rapids (General Petroleum and Rex), formations south of the Bonnyville area between townships 61 to 44 and ranges 1-9 west of the 4th meridian.

Data includes a grid of well-log cross-sections based on approximately 2500 wells (170 deep wells), 55 cores and over 250 km of 2D seismic lines.

The Lloydminster unit forms an elongate south to north (proximal to distal) composite deltaic unit that shows a gradual increase in thickness from 10 to 25 m in the main depocenter followed by a relatively sharp thinning distally to the north to as low as 5 m. The rapid decrease in thickness coincides with the location of the underlying Paleozoic Meadow Lake Escarpment where approximately 200 m of Devonian evaporite rocks onlap to the south onto Ordovician clastics. Over the study area the Meadow Lake Escarpment trends SW-NE.

North of the escarpment the Lloydminster is replaced by the Clearwater which consists of a series of deltaic lobes prograding from ESE to north. Both the Clearwater and Lloydminster members are capped by a regional marine flooding surface that represents the main downlap horizon for the overlaying deltaic and shoreface units within the lower Grand Rapids formation. The lower Grand Rapids consists of several sandier upward lacustrine and bay head delta units that prograde northwards for over 90 km until the projected location of the submerged Meadow Lake Escarpment. Here they aggregate into a 35+ m thick shoreface sand named the Rex member. Rex is the first thick shoreface succession within the Grand Rapids formation and progrades northward for approximately 50 km after which it thins sharply to about10m. From this point it becomes the lowermost part of the General Petroleum member and extends north for tens of km.

Although the role of subsurface complexities (old suture zones or regional fault systems, buried escarpments, etc.) was advocated as a control factor for subsidence and uplift (Zaitlin et al, 2002; Plint and Wadsworth, 2012), the understanding of the mechanisms that govern that interaction is still relatively poor. We document that large scale compensational stacking of deltaic and shoreface sediment bodies coincides with the location of a significant Paleozoic buried structural feature and hypothesize that this structural feature acted as a hinge zone in response to sediment induced flexure.

References

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