Hydrocarbon Exploration in a Glauconitic (Lower Cretaceous) Estuarine Channel System at Halkirk, Alberta

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A Glauconitic estuarine channel complex was mapped in detail from T40, R13W4M to T38, R19W4M as part of an active exploration program conducted from 1991 to 1993. The Halkirk Glauconitic channel fairway runs from east to west, parallel to the Bellshill Lake trend immediately to the north. South of the Halkirk channel system is the Hackett Paleozoic high, which had significant topographic relief at the time of Glauconitic deposition.

Glauconitic channels in the Halkirk area deeply incised into regional Ostracod beds as the result of a fall in relative sealevel. This marked the end of Ostracod deposition and caused the development of a regional unconformity (sequence boundary). Ostracod beds in the study area include several coarsening upward cycles (parasequences) separated by flooding surfaces. Each cycle consists of interbedded sandstone, shale and limestone.

Four principal lithofacies are recognized within the Halkirk channel trend;
(1) Upper estuarine channel sands, (2) Middle estuarine mud-filled channels (active), (3) Fluvial channel sands and (4) Fluvial mud-filled channels (abandoned). Estuarine channel sands are very fine to medium grained sublitharenites. Fluvial sands are very fine to fine grained feldspathic litharenites to lithic arkoses with abundant kaolinite. Estuarine mud-filled channels contain laminae of very fine sand and silt and have a brackish water ichnofacies. Fluvial mud-filled channels lack evidence of bioturbation and consist of massive mudstone with abundant carbonaceous plant material.

A gradual rise in relative sealevel caused infilling of the Glauconitic valley with seaward facies (middle estuarine muds) being superimposed on more landward facies (upper estuarine sands). These valley fill deposits have a total thickness of up to 50m. Stratigraphically equivalent as well as later (Upper Mannville) fluvial channels dissected the Glauconitic sequence, as a result of a subsequent fall in relative sea level. Associated with the earliest fluvial channels are thick shale plugs which are interpreted as abandoned meander cutoffs.

Mud-filled channels overlying and adjacent to estuarine channel sands form numerous stratigraphic traps in the Halkirk Glauconitic trend. Exploration strategy involved drilling strong 2-D seismic anomalies for thick channel sands, followed by extensive 3-D seismic within the channel fairway. The seismic signature of the reservoir facies is greatly influenced by the presence or absence of underlying Ellerslie sands and by the nature of the Paleozoic subcrop (Banff, Exshaw or Wabamun). Deeper structural features such as Stettler salt collapse and drape over the Leduc shelf edge also add to the complexity of the seismic interpretation.