# Depositional models of the gas-producing post-Colorado sequences of the Alberta Basin

T. Jerzykiewicz* and D. Brière
Geoclastica Consulting Ltd. 42 Royal Oak Cove N.W. Calgary, AB, T3G 4X7
tom.geo@telus.net

**ABSTRACT**
Recent discoveries of hydrocarbons in the post-Colorado strata of the Alberta Basin have stimulated exploration for fossil fuels in the Belly River- Edmonton sequence and the overlying Paskapoo Sequence. Both of these depositional sequences contain numerous sandstone bodies of reservoir quality but their facies, stratigraphic framework and geotectonic settings are different. The dominant depositional process which operated during the deposition of the Belly River - Edmonton sequence was a shoreline migration, hence the stratigraphic framework can be based on marine TR cycles. In contrast, the Paskapoo sequence is exclusively continental. Its sedimentation took place far away from the sea coast in a fluvio-lacustrine environment where aggradational processes prevailed and a stratigraphic framework is not easy to establish. The emphasis of this presentation is on the Paskapoo strata which have recently been the subject of exploration for coal-bed methane.

The Paskapoo sequence was deposited in the last stage of the foredeep migration. It forms a clastic wedge which is not affected by thrusting and preserved in the core of the Alberta Syncline. The maximum thickness of the wedge near the axis of the basin in the Hinton area is as much as 1300 m and it wedges out toward the east. This wedging can be seen basin-wide. In some areas near the Red Deer River Valley, like the Hand Hills and on top of the Cypress Hills, the Paskapoo is capped by late Tertiary deposits allowing direct measurement of the pre-late Tertiary thickness of Paleocene strata on the eastern flank of the Alberta Basin above the Cretaceous-Tertiary boundary time line.

The focus of our detailed facies analysis and high-resolution stratigraphic correlation has been on the Paskapoo clastic wedge in Drayton Valley area where some hydrocarbons have recently been discovered in the Paskapoo sandstone. The external geometry of the Paskapoo wedge, its lithology, and internal distribution of sedimentary facies have been studied along SW-NE cross-section between the Foothills and the Plains. The cross-section was selected so as to obtain a perpendicular transect of the Paskapoo wedge from its proximal part in the Foothills to its distal edge in the Plains. Accordingly, the line of the cross-section runs from outcrops of the Paskapoo Formation in the Blackstone River valley across the axis of the Alberta Syncline to the Paskapoo exposures in the vicinity of Entwistle and Wabamun Lake. Lithology and sedimentary facies have been studied in outcrops and on electric logs. Petrophysical methods based on density, neutron, gamma ray and resistivty curves have been applied. Datum

for the stratigraphic correlation has been placed on the Cretaceous-Tertiary boundary (the boundary which has previously been very precisely established by palynological and geochemical methods and is known to occur at the bottom of the Ardley Coal Zone in the Plains and at the bottom of the Coalspur Coal Zone in the Foothills). The main reason behind utilizing the K-T boundary as the datum for our cross-section is the fact that this boundary is the only marker which has been positively identified basin-wide. Other reasons for the departure from the traditional approach of utilizing the Battle horizon as the datum will be discussed during the oral presentation.

The Paskapoo wedge as it is presented on the cross-section consists of a thick pile of sediments in the middle of the basin and only thin deposits interrupted by disconformities on the eastern flank of the basin. Such strongly asymmetric external geometry of the wedge, internal arrangement of facies and presence of unconformities is based on several lines of evidence including geological mapping, sedimentology, palynology, magnetostratigraphy, and petrophysics.

Concerning the petrophysical evidence, the Paskapoo strata have been studied with a simple method that uses density, neutron, sonic, gamma ray and resistively logs. The method seeks to correlate individual coal seams by establishing their log signature. This method makes it possible to better understand the stratigraphy and structure of the Paskapoo wedge.

There are two main conclusions for exploration which stem from our interpretation of the external geometry of the Paskapoo clastic wedge and its internal architecture. The first concerns the application of log signatures to find the source of coal bed methane in contact with sandstone layers as potential gas reservoirs. Calibrated with cored coal and combined with an understanding of sedimentology and regional geology, this method should become a powerful tool in the exploration for shallow gas.

The second conclusion further refines the clastic wedge model. There may be either erosional surfaces at disconformities, or pinched-out intervals of overbank deposits in the vertically stacked channel sandstones. The presence and the signature of the coal seams help to indicate the dominant environment and therefore support regional depositional modeling in gas producing post-Colorado sequences throughout the Alberta Basin.