# Potential Structural and Stratigraphic Traps of the Peel Plateau, Yukon

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## Summary

Interpretations of vintage seismic reflection data on the Peel Plateau, Yukon shows that a number of promising potential structural and stratigraphic traps exist. This region is undergoing reevaluation as a potentially productive hydrocarbon province but a lack of outcrops has limited geologic interpretations. The lithologic transition from Paleozoic carbonate platform to basinal shales has been penetrated by only one well; its breadth and orientation have been a matter of conjecture. Historically the deformation front of the Richardson Anticlinorium has been generalized into a single thrust fault, the Trevor thrust. We interpret thrust faults, folds and back thrusts as well as the margin transition over an along strike distance of ~85 km from seismic data collected during exploration in the 1960's and 1970's. Integrating these interpretations with aeromagnetic data allows us to create preliminary maps of subsurface folds and thrust faults of the deformation front. Facies pinch outs and faulted anticlines are potential hydrocarbon traps although plays in this region have yet to be proven.

## Introduction

Exploration in the 1960's and 1970's encountered a variety of oil and gas shows in the western Peel Plateau (Allen et al., 2010) but no further development was undertaken. In the last fifteen years hydrocarbon potential of the region has been reassessed based on geologic field work and analytical techniques not available 40 years ago (e.g. Osadetz et al., 2005; Pyle and Jones, 2009; Allen and Fraser, 2010). The eastern deformation front of the Richardson Anticlinorium lies in this area but sparse outcrop results in poor constraints on subsurface compressive deformation. The lateral facies changes of the Paleozoic platform to basinal shale transition has been identified from one well, but its geometry is only revealed by the seismic data. We present structural and stratigraphic interpretations of seismic data collected approximately forty years ago that are publicly available from the National Energy Board.

## Methods

We have interpreted twenty two lines of vintage seismic reflection data and integrated these interpretations with the first derivative of regional aeromagnetic data. Two key wells, the Gulf Mobil Caribou YT N-25 and the Mobil Gulf Peel H-71 provided direct ties to seismic penetrating Paleozoic basinal and marginal lithologies and the younger clastic successions. Several other wells provided stratigraphic context. Interpretations of faults observed in shallow depth sections were projected through noise to the surface; these points corresponded to locations of long narrow anomalies in the first derivative of the aeromagnetic data (Geophysical Data Centre, Natural Resources Canada, (http://gdcinfo.agg.nrcan.gc.ca/gdc/index_e.html). Using an empirical correlation between projected fault tips to the anomalies allowed us to construct a preliminary map of faults and their segmentation in the deformation front.

## Interpretations

The main features interpreted in the seismic reflection data are mild compressional deformation that cut through lateral facies changes in Paleozoic sediments. These facies transitions created a variety of reflector geometries in Cambrian to Devonian strata. They have not been perfectly imaged because of disruption by compressive deformation; however, pinching out of the Slats Creek Formation, clinoforms, abrupt changes in dip and/or thickness of layers and a carbonate buildup all occur within an area 10□-20 km wide and sub-parallel to the Richardson Trough. Folds, thrust faults and back thrusts of early Tertiary age (Lane, 1998) deform the Paleozoic and Cretaceous strata. Many of the faults terminate in shallow noise and we cannot determine if the Cretaceous strata are merely folded or have been faulted. In one line reflectors in the Tuttle Formation are continuous above the tip of the thrust fault. At depth many of the thrust faults can be seen cutting the base Cambrian unconformity. Folding and faulting are concentrated in lateral changes in facies, leaving stretches of the basin and the platform on either side relatively undeformed. It is clear that no single through-going fault (Norris, 1981) defines the eastern edge of Tertiary deformation associated with the Richardson Anticlinorium. Rather, it is defined by an array of discontinuous structures consisting of thrust faults, back-thrusts and folds.

## Conclusions

Our interpretations show that numerous untested potential structural and stratigraphic traps occur in the western Peel Plateau. Vintage seismic reflection lines on the eastern side of the Richardson Anticlinorium imaged early Tertiary deformation that broke through the lithologic pinch out of syn-rift sandstone as well as the transition from platform carbonates to basinal shales. Only one well has been drilled into the deformed marginal facies and another into a broad fold of the basinal and overlying sediments. Combining seismic interpretations with aeromagnetic first derivative data we have created a preliminary map of these subsurface structures. A gas seep of probable thermogenic origin (Allen et al., 2010) occurs above the axis of an anticline. Lateral facies changes and compressive structures have been productive further south in the Western Canada Sedimentary Basin; their existence in the Peel Plateau reinforces the more optimistic recent assessments of hydrocarbon potential in the region (Pyle and Jones, 2009; Allen and Fraser, 2010).

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