# Paleozoic Petroleum Systems of the Northern Williston Basin: a Quantitative Basin Modeling Assessment

**Oluseyi Olajide and Stephen Bend**
*University of Regina*

## Abstract

A series of 1D, 2D and 3D models of the Paleozoic petroleum systems within the northern portion of the Williston Basin were created by integrating geological, geophysical, geochemical subsurface data. The primary goal of this study is to quantitatively assess the response of source rock maturation, petroleum generation, expulsion, migration and accumulation within the Phanerozoic during the evolution of the Williston Basin. A suggested mechanism of subsidence of the basin by Klein and Hsui (1987) and Quinlan (1987) forms the basis of the modelling methodology employed in this study expressed as McKenzie's uniform lithospheric stretching methodology. This study also takes into account the Sub-Tertiary, Sub-Cretaceous, Sub-Jurassic, Sub-Triassic, Sub-Devonian and Mid-Ordovician erosional events using the McKenzies lithospheric stretching methodology augmented by traditional methods. Paleobathymetry data was generated within the model and calibrated using reported biostratigraphic data. Measured bottom hole geothermal data, calculated present day heat flow, simulated paleo-heat flow solutions and full geochemical analyses (i.e. RockEval, organofacies, kinetics) were applied to the maturation solutions of each source rock unit.

The resulting source rock maturity history and hydrocarbon generation models suggest that Lower Paleozoic source rock units within the southern Saskatchewan, particularly the Upper Cambrian to Ordovician source rocks attain maturity by the late Paleozoic. In contrast, other Paleozoic source intervals such as the Bakken and Lodgepole Formation don't reach maturity until the Late Cretaceous to the Paleogene time using standard kinetic parameters. The 1D, 2D and 3D basin models also identify (and replicate) existing oil/gas pools as well as 'micro kitchens' of probable generation for stratigraphic units of the mid to late Paleozoic. Petroleum migration from source rock into the trap is a combination of lateral and vertical migration.