

Proterozoic Influence on Phanerozoic Geology in the Northwestern Interior Plains, Canada

B.C. MacLean* and D.G. Cook
C.S. Lord Northern Geoscience Centre
P.O. Box 1500, 4601-B 52nd Ave., Yellowknife, NT X1A 2R3
Bernie_MacLean@gov.nt.ca

ABSTRACT

Under the Northwestern Interior Plains of the Northwest Territories Phanerozoic strata unconformably overlie a thick (>10 km), stratified, Proterozoic section, which in turn overlies Precambrian crystalline basement. Although the top of the Proterozoic is generally considered to represent 'economic basement' the Proterozoic history is important to exploration because Proterozoic structures provided zones of weakness that localized a variety of Phanerozoic depositional and structural features. Among a number of Proterozoic compressional and extensional tectonic events the most important is the compressional Forward Orogeny, which saw the generation of, 'Wyoming' style, basement-cored fault blocks and anticlinal folds. Phanerozoic reactivations of early structures range in age from Cambrian to Cretaceous.

The north-northwest trending 'Laramide' Colville Hills anticlines and faulted anticlines display a general correspondence to Forward Orogeny structural trends. Some of the 'Laramide' structures, including the gas-bearing Tweed Lake anticline, were controlled by reactivation of ancestral faults. Structures which may be related to the Colville Hills deformation are broadly distributed and occur well beyond the limits of the Colville Hills geographic area. They include steep faults on Brock Inlier to the northeast and the McConnell Range of the Franklin Mountains to the south.

Imperial Anticline, which lies between the Mackenzie and Franklin Mountains is an unusual fault-bend fold that was controlled by Proterozoic structure and stratigraphy. Lower and/or Middle Cambrian strata up to 400 m thick in the footwall comprise a high-risk exploration play.

The Cambrian intra-cratonic Mackenzie Trough contains up to 1500 m of Cambrian strata including basal sands correlative with the gas-bearing Mount Clark Formation in the Colville Hills. The Cambrian trough overlies and seemingly mimics a large Proterozoic synclinal structural basin.

An anomalous Middle Cambrian salt unit encountered in the Shell Keele River L-04 well has not been found beyond the limits of Mackenzie Trough. The L-04 structure is revealed by seismic to be a salt pillow and similar pillows or diapirs may occur within the trough and create traps.

Finally, extension, expressed by the presence of half grabens, grabens and monoclinial flexures including ages of Cambrian, post-Devonian and post - Cretaceous are much more common than is generally recognized in the published literature. Many resulted from reactivation of Proterozoic faults.