

# Subaerial Unconformities in the Upper Devonian Snipe Lake Reef Complex, West-Central Alberta

Beverly J. Mack\*<sup>1</sup> and Nancy Chow  
University of Manitoba, Winnipeg, Manitoba  
bjswmack@telus.net  
n\_chow@umanitoba.ca

<sup>1</sup>Present address: ConocoPhillips Canada, Calgary, Alberta

## Summary

The isolated Snipe Lake reef complex in the Swan Hills Formation (Lower Frasnian) is a well-preserved oil-bearing reef in west-central Alberta. This study focuses on the major subaerial unconformities, P4 and R0.5, which formed as a result of relative falls in sea-level. The lower P4 unconformity occurs in the upper part of a laterally restricted, upper platform stage and has been widely correlated to coeval carbonate banks. The upper R0.5 unconformity occurs at the top of a progradational phase of a rimmed reef complex stage. It has been recognized in at least one other Swan Hills reef complex (Judy Creek).

Lithofacies directly beneath these unconformities are distinguished by a variety of early diagenetic features which are interpreted to be of pedogenic origin. The preserved paleosol profiles extend as deep as 2.1 m below the P4 unconformity and 1.3 m below the R0.5 unconformity. Although there is some variability, the different profiles generally show a relatively consistent vertical arrangement of paleosol features where (1) green shale beds are developed in the upper part of the profile, typically in tidal flat lithofacies (peloid packstones) or open lagoonal facies (branching cylindrical stromatoporoid floatstones, light tan *Amphipora* floatstones); (2) rhizoliths are relatively rare and occur high in the profile; (3) desiccation cracks and solution vugs filled by green shale, as well as solution vugs occluded by marine pendant calcite cements, are developed lower in the profile in open lagoonal, reef flat (stromatoporoid rudstones-floatstones) or coarse-grained beach (robust branching cylindrical stromatoporoid rudstones) facies; and (4) laminar calcretes are commonly present throughout the profile. No apparent patterns were observed in the spatial distribution of pedogenic features across the Snipe Lake reef complex, although the number and distribution of wells examined in this study were limited.

Comparison of the P4 and R0.5 paleosol profiles indicates that the major extrinsic controls on pedogenesis in the Snipe Lake reef complex are the extent of relative sea-level fall and the amount of shoreface erosion during the subsequent marine transgression. The P4 unconformity is interpreted to represent an estimated ~2.5 to 3 m of relative sea-level fall with only minor erosion during the ensuing transgression. Relative sea-level fall associated with the R0.5 unconformity is estimated to be ~2.5 to 3 m, based on comparison with the Judy Creek reef complex, with least 1.5 to 2 m of shoreface erosion during the transgression. The major intrinsic controls are parent-material lithology, particularly porosity and permeability; limited vegetation developed on the exposure surfaces; low topographic relief on the top of the platform and reef interior; and the geographic isolation of the reef complex.

Subaerial exposure at the P4 and R0.5 unconformities at the Snipe Lake reef complex has had minimal effect on the reservoir quality of the underlying facies. Solution vugs and desiccation cracks are typically occluded by green shale, pendant calcite cements, and burial calcite and dolomite cements.