Subaerial Exposure Surfaces in the Judy Creek Reef Complex (Upper Devonian), West-Central Alberta

Nancy Chow*
Department of Geological Sciences, University of Manitoba,
Winnipeg, MB R3T 2N2
n_chow@umanitoba.ca

and

Jack Wendte
Geological Survey of Canada, Calgary, AB

ABSTRACT

The Judy Creek reef complex is one of the many hydrocarbon-bearing isolated buildups in the Swan Hills Formation (earliest Frasnian age) in the subsurface of west-central Alberta. Seven megacycles, each ~10 m thick, are defined by backsteps along the margin and can be correlated throughout the complex. The top of the fourth megacycle, referred to as R_4, is distinguished from the other megacycle contacts by the presence of paleosol and paleokarst features. In addition, a second subaerial exposure surface, $R_{0.5}$, occurs near the middle of the first megacycle and can be recognized throughout the interior of the buildup.

The $R_{0.5}$ cycle contact corresponds to the top of a well-preserved paleosol developed on peloidal-skeletal grainstone to stromatoporoid rudstone deposited along the shoreline. The paleosol profile, up to 2 m thick, includes (from top to bottom): pedogenic green shale, rhizoliths with cutans, illuviated green shale in thin beds and filling fractures, crackle breccia, and pendant cements in vugs. Thin laminar calcrete is common throughout and glaebules, circumgranular cracks and microcrystalline dolostone are present locally. Lateral variations in profiles are a function of erosion during the ensuing transgression.

The R_4 cycle contact is characterized by a paleokarst surface developed on peloidal mudstone to grainstone. The irregular surface exhibits cm-scale relief and is locally overlain by pedogenic green shale and lithoclasts. Solution-enlarged subhorizontal fractures and small vugs, which are filled by green shale, are ubiquitous below the karsted surface and have been observed down to ~3 m below the surface. R_4 is interpreted to be the eroded surface of a paleosol profile, where ~1-2 m was removed during the subsequent transgression. The differences between the $R_{0.5}$ and R_4 paleosols are attributed to variations in substrate lithology, the extent and duration of relative sea-level fall and the extent of erosion during transgression. A number of other subaerial exposure surfaces between $R_{0.5}$ and R_4 have been recognized in individual cores but cannot be correlated.